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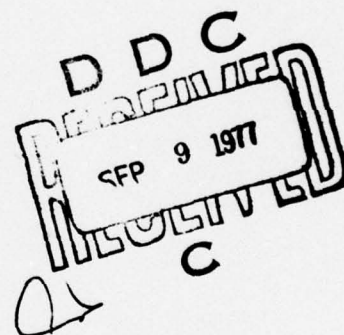
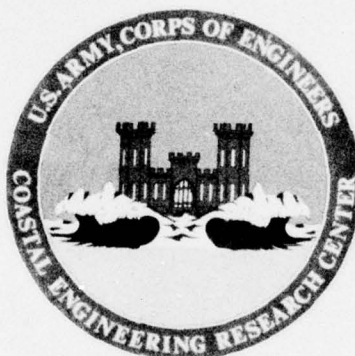
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# A Simple Computer Model for Evaluating Coastal Inlet Hydraulics

by  
William N. Seelig

COASTAL ENGINEERING  
TECHNICAL AID NO. 77-1  
JULY 1977



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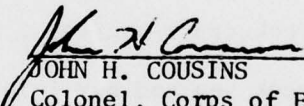
## PREFACE

This report describes a method for estimating inlet velocities, discharge, and bay levels based on the numerical model of Seelig, Harris, and Herchenroder (in preparation, 1977). This method for predicting inlet hydraulics is not discussed in the Shore Protection Manual (SPM) (U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975). The work was carried out under the General Investigation of Tidal Inlets (GITI) of the U.S. Army Coastal Engineering Research Center (CERC).

The report was prepared by William N. Seelig, Research Hydraulic Engineer, under the general supervision of Dr. R.M. Sorensen, Chief, Coastal Structures Branch.

Comments on this publication are invited.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

  
JOHN H. COUSINS

Colonel, Corps of Engineers  
Commander and Director

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# CONTENTS

	Page
CONVERSION FACTORS, U.S. CUSTOMARY TO METRIC (SI) . . . .	5
SYMBOLS AND DEFINITIONS . . . . .	6
I INTRODUCTION. . . . .	7
II PREDICTING INLET HYDRAULICS . . . . .	7
1. Systems Modeled with Computer Program. . . . .	7
2. Procedures for Use of Computer Program . . . . .	7
III EXAMPLES OF COMPUTER PROGRAM PREDICTION . . . . .	11
1. Cabin Point Creek, Virginia. . . . .	11
2. Pentwater Inlet, Michigan. . . . .	15
IV SUMMARY . . . . .	19
APPENDIX COMPUTER PROGRAM DOCUMENTATION (INLET). . . . .	21

## TABLE

Predicted Cabin Point Creek hydraulics. . . . .	13
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## FIGURES

1 Inlet-bay system. . . . .	8
2 Cabin Point Creek, Virginia . . . . .	12
3 Cabin Point Creek cross-section . . . . .	12
4 Cabin Point Creek sea and bay levels. . . . .	14
5 Pentwater Inlet, Michigan . . . . .	16
6 Pentwater Inlet model prediction of monochromatic forcing . . .	17
7 Pentwater Inlet model calibration . . . . .	18
8 Predicted Pentwater Inlet velocities, discharge, and bay levels, and relative magnitude of terms in the equation of motion. . . . .	20

CONVERSION FACTORS, U.S. CUSTOMARY TO METRIC (SI)  
UNITS OF MEASUREMENT

U.S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	by	To obtain
inches	25.4	millimeters
	2.54	centimeters
square inches	6.452	square centimeters
cubic inches	16.39	cubic centimeters
feet	30.39	centimeters
	0.3048	meters
square feet	0.0929	square meters
cubic feet	0.0283	cubic meters
yards	0.9144	meters
square yards	0.836	square meters
cubic yards	0.7646	cubic meters
miles	1.6093	kilometers
square miles	259.0	hectares
knots	1.8532	kilometers per hour
acres	0.4047	hectares
foot-pounds	1.3558	newton meters
millibars	$1.0197 \times 10^{-3}$	kilograms per square centimeter
ounces	28.35	grams
pounds	453.6	grams
	0.4536	kilograms
ton, long	1.0160	metric tons
ton, short	0.9072	metric tons
degrees (angle)	0.1745	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins <sup>1</sup>

<sup>1</sup>To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use formula:  $C = (5/9) (F - 32)$ .

To obtain Kelvin (K) readings, use formula:  $K = (5/9) (F - 32) + 273.15$ .

# SYMBOLS AND DEFINITIONS

$A_{bay}$	bay surface area (square feet)
$A_0$	bay surface area at datum (square feet)
$C1, C2$	coefficients to evaluate Manning's $n$ (dimensionless)
$d_{bay}$	depth of bay (feet)
$d_{max}$	maximum water depth in inlet (feet)
$D$	stillwater depth (feet)
$g$	acceleration of gravity (32.2 feet per second squared)
$h_b$	water level in bay (feet)
$h_s$	water level in sea (feet)
$L_{bay}$	length of bay (feet)
$L_{in}$	length of inlet (feet)
$T_F$	forcing wave period (seconds)
$t$	time step used in model (seconds)
$\beta$	bay surface area variation parameter (dimensionless)

# A SIMPLE COMPUTER MODEL FOR EVALUATING COASTAL INLET HYDRAULICS

by  
William N. Seelig

## I. INTRODUCTION

This report describes a method for estimating coastal inlet velocities, discharge, and bay levels using the simple numerical model of Seelig, Harris, and Herchenroder (in preparation, 1977)<sup>1</sup>. The model can be used for sea level fluctuations caused by astronomical tides, storm surges, seiches, or tsunamis. A digital computer program is used because of the large number of computations. A run on a CDC 6600 computer generally costs less than \$5 for a tidal cycle.

## II. PREDICTING INLET HYDRAULICS

### 1. Systems Modeled with Computer Program.

An inlet-bay system consists of a "sea" (e.g., ocean or lake) connected to a "bay" by one or more inlets (Fig. 1). The computer model will predict bay levels, inlet velocities, and discharge as a function of time given the geometry of the system and the water level fluctuations in the sea. It is assumed that the sea is much larger than the inlet and bay and that the bay is large compared to the inlet.

The model is designed for systems where the bay water level rises and falls uniformly throughout the bay. This occurs when the wavelength in the bay is much longer than the longest axis of the bay:

$$T_F \sqrt{gd_{bay}} \gg L_{bay} , \quad (1)$$

where

$T_F$  = forcing wave period

$g$  = acceleration of gravity

$d_{bay}$  = depth of bay

$L_{bay}$  = length of bay

### 2. Procedures for Use of Computer Program.

Step 1. Evaluate the inlet geometry by using maps, charts, hydrographic surveys, and dredging records to determine the depth of water throughout the inlet. The side slope of the inlet at mean water level

<sup>1</sup>SEELIG, W.N., HARRIS, D.L., and HERCHENRODER, B.E., "A Spatially Integrated Numerical Model of Inlet Hydraulics," GITI Report 14, U.S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, Va., and U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. (in preparation, 1977).

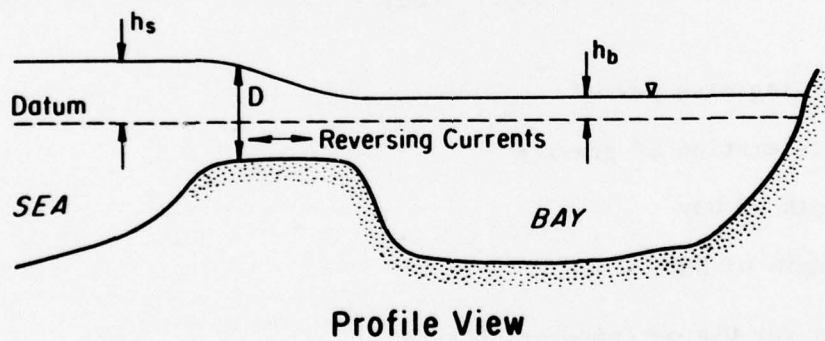
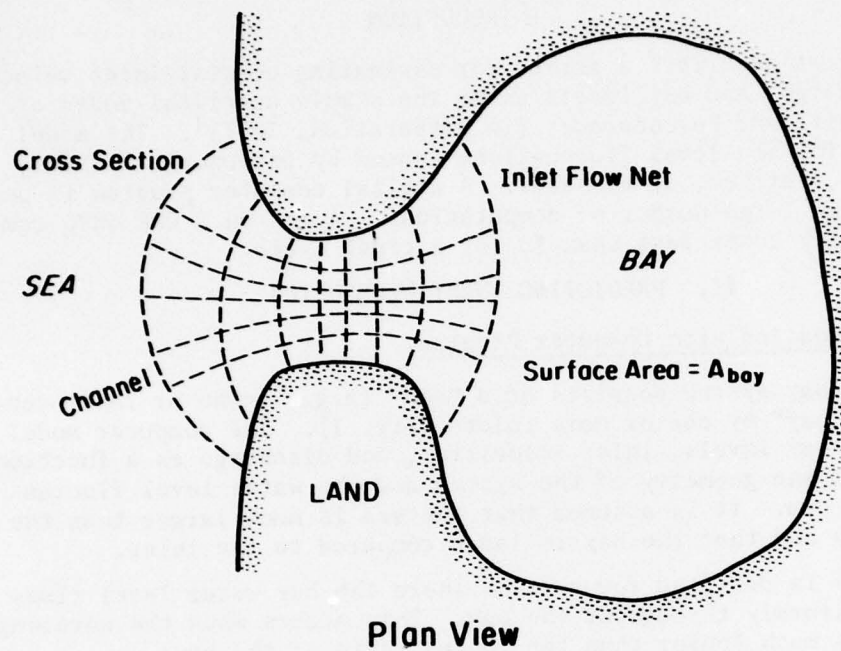


Figure 1. Inlet-bay system.

should also be measured. Whenever possible, obtain this information for the time of interest because inlets frequently change shape, especially during major storms.

**Step 2.** Construct a flow net (series of cross sections and channels) for the inlet to represent the model grid (Fig. 1). The flow net and inlet discharge are used to determine bottom friction throughout the inlet. The flow net is drawn by approximating the average path (channel) that water follows during ebb flow and floodflow. Channel boundaries are drawn along these paths for up to seven channels. A simple inlet with constant depth and width may be modeled with one or two channels. Complex inlets require approximately three to seven channels. Channels should have the smallest spacing in deep parts of the inlet where flow will be highest. Up to eight cross sections should then be drawn perpendicular to the channels. The first cross section in the sea and the last cross section in the bay should have cross-sectional areas 10 times larger than the minimum cross-sectional area. Cross sections should be drawn with the narrowest spacing near the minimum cross-sectional area section where friction in the inlet will be high.

**Step 3.** Measure the surface area of the bay at the mean water level,  $A_0$ , from charts or aerial photos. For most bays the surface area changes as the bay water level rises and falls because sections are flooded at high water levels. If the bay area change is significant, a bay area variation parameter,  $\beta$ , is used to account for area of the bay,  $A_{bay}$ , at any water level in the bay,  $h_b$ , using the relation:

$$A_{bay} = A_0(1 + \beta h_b) , \quad (2)$$

where  $A_0$  is the bay surface area at datum, usually mean low water (MLW), mean sea level (MSL), or mean water level (MWL).

**Step 4.** Specify the seawater level fluctuation as a function of time for the period of interest. Tide tables will give an estimate of the astronomical tide. Water levels can also be measured by a tide gage and stilling well (Seelig, 1977)<sup>2</sup>. Corps of Engineers and National Oceanic and Atmospheric Administration (NOAA) gages located at numerous points along the coast may also provide the desired water level information. In this computer program either the tide may be expressed as a sinusoidal wave with a period and amplitude or the levels may be described by instantaneous sea level measurements at a constant sampling rate.

**Step 5.** Determine the time step of input to the model for use in computations. As a lower limit, the time step,  $\Delta t$ , should be:

$$\Delta t = \frac{L_c n}{\sqrt{gd_{max}}} , \quad (3)$$

<sup>2</sup>SEELIG, W.N., "Stilling Well Design for Accurate Water Level Measurement," TP 77-2, U.S. Army, Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, Va., Jan. 1977.

where  $L_{in}$  is the length of the inlet and  $d_{max}$  is the maximum water depth in the inlet. A longer time step can be used for most tidal inlets, and as an upper limit, the time step should be one-hundredth of the forcing wave period.

Step 6. Document all input data using the computer format shown in the appendix. As a first estimate, set the flood and ebb entrance and exit loss coefficients to equal one (CDF = 1.0 and CDE = 1.0). As a first approximation, Manning's  $n$  can be evaluated by the relation:

$$n = C1 - C2 D, \quad (4)$$

where  $D$  is the local inlet stillwater depth. For depths greater than 4 feet and less than 30 feet,  $C1 = 0.03777$  and  $C2 = 0.000667$ ; for depths less than 4 feet,  $C1 = 0.0550$  and  $C2 = 0.005$ . The  $n$  for each grid may be different if  $C2 \neq 0$ .

Step 7. For use with periodic forcing, run the program for several sinusoidal cycles having the period and amplitude of the long wave of interest to approximate the hydraulic characteristics of the inlet-bay system. A sinusoidal tide is specified in the model by giving the forcing period,  $T$ , in hours and the wave amplitude,  $A_0$ , in feet, on card type 3 and by setting NPTS = 0 on card type 8 of input to the program INLET. Set ITABLE = 1 to obtain tables of instantaneous hydraulics at points throughout the water level cycle and set IPLOT = 1 to obtain a plot of predicted inlet velocities and discharge at sequential bay levels. These outputs will indicate the importance of the terms in the equation of motion describing water motion in the inlet. If temporal acceleration is small during most of the water level cycle, then startup transients will be small and the first or second cycle will contain little transient effect (NCYCLES = 1 or 2 in input data). However, if temporal acceleration is significant during more than 25 percent of the cycle, approximately four cycles of model operation are required to eliminate startup transient effects (NCYCLES = 4). For aperiodic use such as with storm surges or rapidly varying wave size (e.g., tsunamis), run the model for the water level for approximately 10 hours before the time of interest to build up initial conditions in the model similar to the prototype.

Step 8. Calibrate the computer model by varying Manning's  $n$  or flood- and ebb-loss coefficients. The seawater level fluctuation can be specified as a sinusoidal wave or in terms of an equal time series. For an equal time series, start and stop the series when the seawater level is at zero so that one or more complete cycles are described. Use at least 20 points to describe each cycle. The sampling interval in minutes, TDEL, and the number of points, NPTS, must be specified on card type 8 and the water level data on card type 9.

The model is calibrated using short periods of field observations by first comparing observed and predicted mean water velocities, if available, at the minimum cross-sectional area region of the inlet. If the predicted velocities are higher or lower than observed, then the value

of  $n$  can be increased or decreased accordingly. When the computer model has been satisfactorily calibrated to predict inlet velocities, predicted bay water levels should be checked against measurements to assure that levels are being modeled correctly. If inlet velocities are not available, bay levels can be used to calibrate the model.

Step 9. If additional prototype data are available, these data should be used to verify that the model adequately predicts inlet and bay hydraulics.

Step 10. At this point the computer program is ready to use for prediction. Examples of the use of the computer program are presented in the following section. Input and output data, and computations are in U.S. Customary units.

### III. EXAMPLES OF COMPUTER PROGRAM PREDICTION

#### 1. Cabin Point Creek, Virginia.

Cabin Point Creek is a shallow natural tidal inlet that connects a bay to the lower Potomac River (Fig. 2) where the mean tidal range is approximately 1.5 feet.

In this example, the model was calibrated with prototype river and bay levels and the calibrated model was then used to predict inlet velocities, discharge, and bay level for a second inlet added to the system. The procedures for using the model are:

(a) The inlet cross section was measured (Fig. 3) on 24 May 1976, and is assumed to be representative of the 1,900-foot-long inlet.

(b) The inlet is modeled using a grid system of three channels and two identical cross sections (Fig. 3) at either end of the inlet.

(c) The bay area,  $A_0$ , measured from a  $7\frac{1}{2}$ -minute U.S. Geological Survey (USGS) topographic map, was  $3.5 \times 10^6$  square feet. For an increase in bay water elevation of 0.25 foot, the bay surface area increases approximately 5 percent because of marsh flooding. The bay area variation parameter,  $\beta$ , can be determined from this information using equation (2), rearranged as:

$$\beta = \frac{1}{h_b} \left( \frac{A_{bay}}{A_0} - 1 \right) , \quad (5)$$

or, in this case,

$$\beta = \frac{1}{0.25} (1.05 - 1) = 0.2$$

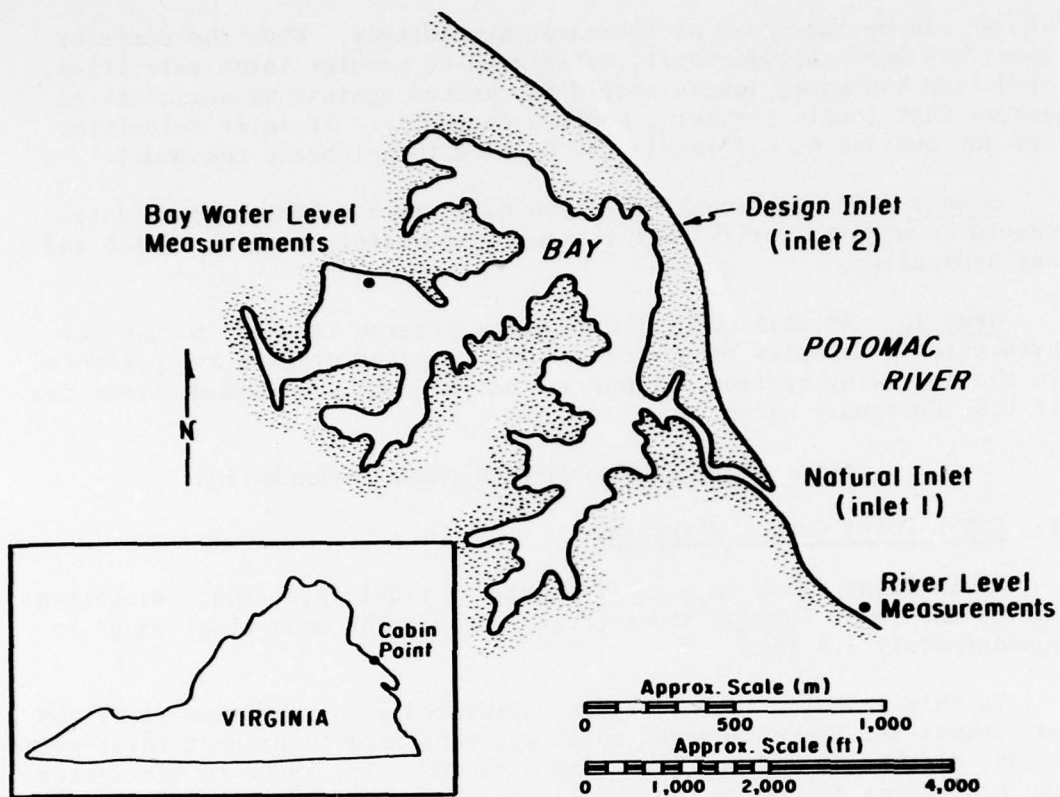


Figure 2. Cabin Point Creek, Virginia.

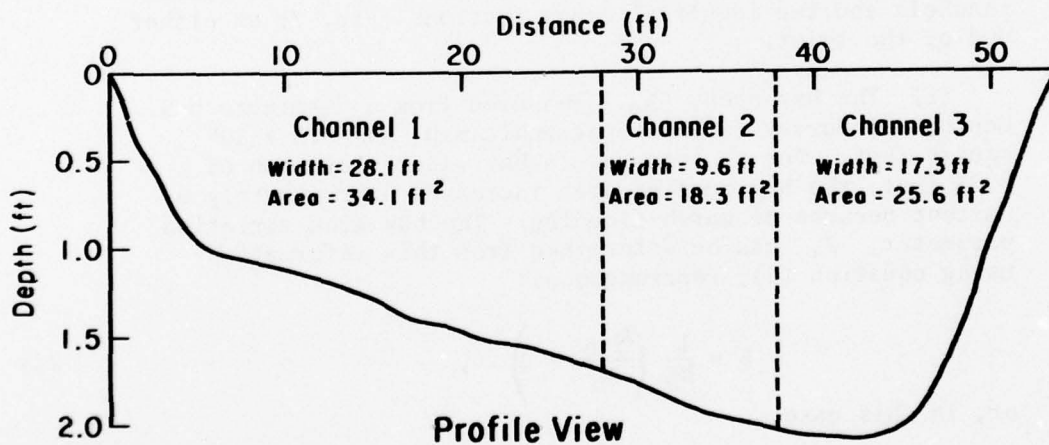


Figure 3. Cabin Point Creek cross section.

(d) River water levels were measured at 30-minute intervals using a stilling well located near the inlet mouth (Fig. 2).

(e) The time step was estimated as:

$$\Delta t = \frac{1900}{\sqrt{32.2 \times 2}} = 250 \text{ seconds}$$

(f) Loss coefficients were specified as CDF = CDE = 1.0, and Manning's n was estimated as  $n = 0.055 - 0.005 D$  (recommended for depths less than 4 feet).

(g) A preliminary computer run using a sinusoidal river tide showed that the inlet is controlled by friction effects and that temporal acceleration is not important.

(h) The model was then run using the measured river water levels to force the model (Fig. 4). It was determined that the model adequately predicted bay levels.

(i) No additional prototype data are available for verification of the model.

(j) The model is now available to use for predictions of inlet hydraulics. In this example, a second inlet (inlet 2), is being considered for this site, so the model is used to predict hydraulics for the system with two inlets (Fig. 2). Procedures (a) and (b) are repeated for the second inlet. In this case, the second inlet is modeled by one channel and two cross sections so that the inlet has a length of 300 feet, a width of 50 feet, and a depth of 4 feet. These inlet data are put into the computer format, added to the program deck for the natural inlet, and re-run to predict conditions for the proposed two-inlet system. The numerical model predicts that addition of the second inlet would increase the tidal range and the tidal prism in the bay and would cause water velocities in inlet 1 to decrease (see Table).

Table. Predicted Cabin Point Creek hydraulics.

Tide	24 and 25 May 1976	Model prediction for second inlet	
	Inlet 1	Inlet 1	Inlet 2 <sup>1</sup>
Bay (range in ft)	0.36	1.49	1.49
Ebb (maximum velocity in ft/s)	-0.6	-0.3	-1.3
Flood (maximum velocity in ft/s)	0.9	0.3	1.7

<sup>1</sup>L = 300 feet, B = 50 feet, D = 4 feet.

NOTE: Tidal range in the sea is 1.49 feet.

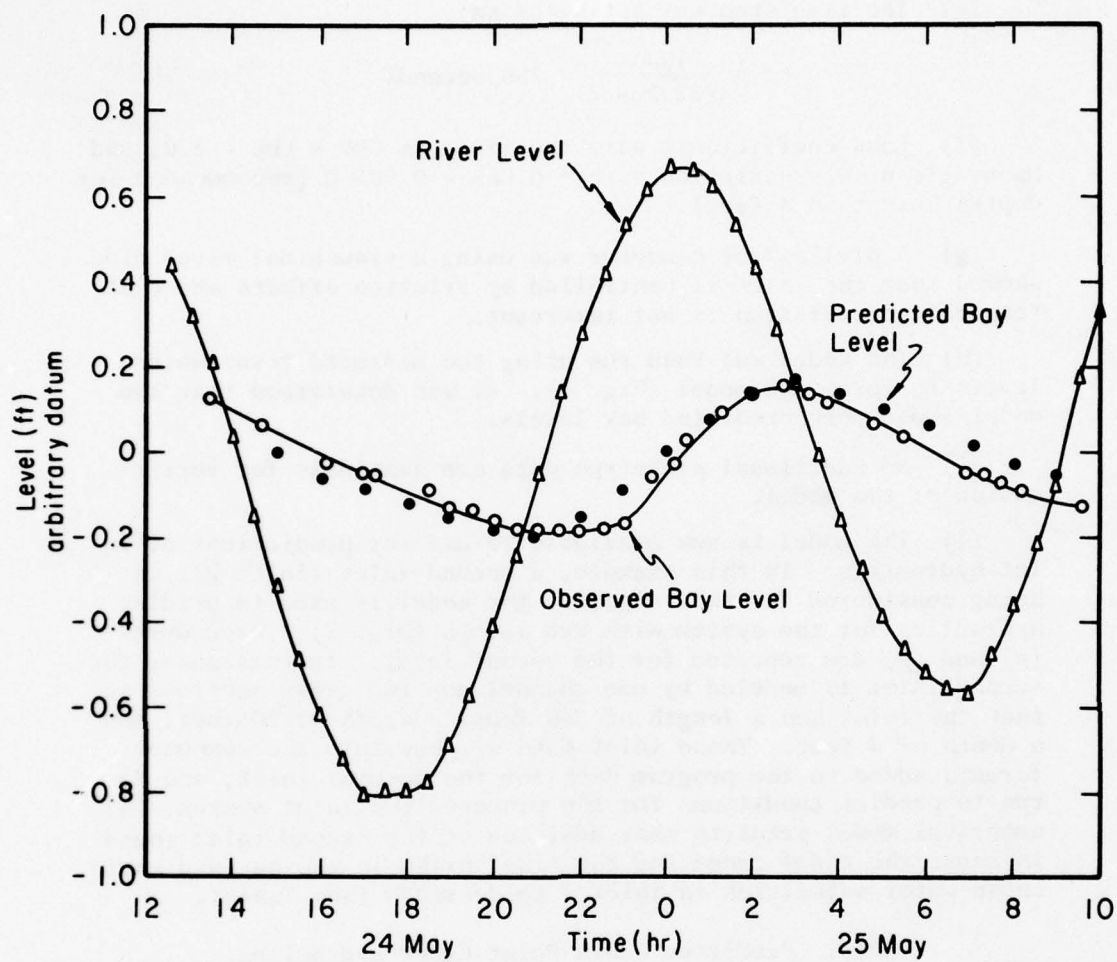


Figure 4. Cabin Point Creek sea and bay levels.

## 2. Pentwater Inlet, Michigan.

Pentwater Inlet is an example of a Great Lakes inlet controlled by vertical-walled jetties along the entire 2,000-foot channel (Fig. 5). Meteorologically generated seiches of Lake Michigan are the primary water level fluctuations causing reversing currents in the inlet. A model of Pentwater will be calibrated and used to estimate hydraulic response of the inlet to simultaneous lake seiching and river inflow. The procedures used in this modeling are:

(a) A hydrographic survey of the inlet is used to describe the inlet geometry.

(b) The inlet is modeled using one channel and six cross sections.

(c) The bay surface area, measured from a hydrographic chart, is  $1.81 \times 10^7$  square feet. The bay area does not change with bay water level because the bay has steep-sided slopes, so  $\beta = 0$ .

(d) Lake Michigan water level measurements used to force the model were taken at 5-minute intervals on a tower located adjacent to Pentwater Inlet.

(e) The model time step used is:

$$\Delta t = \frac{2000}{\sqrt{32.2 \times 15}} = 90 \text{ seconds}$$

(f) Loss coefficients were specified as  $CDE = CDF = 1.0$ , and Manning's  $n$  was estimated by  $n = 0.03777 - 0.000667 D$  (recommended for depths greater than 4 feet and less than 30 feet).

(g) A preliminary run showed that temporal acceleration is an important term in the inlet equation of motion for Pentwater Inlet (Fig. 6). Therefore, several forcing cycles of model operation before the time of interest are necessary to eliminate transient terms due to startup conditions.

(h) The model is calibrated by using Lake Michigan levels to force the model. An initial run showed that predicted bay level fluctuations adequately modeled observed levels (Fig. 7).

(i) The model was not verified.

(j) The model was used to predict inlet velocities, discharge, and bay levels for a 2-hour forcing wave with an

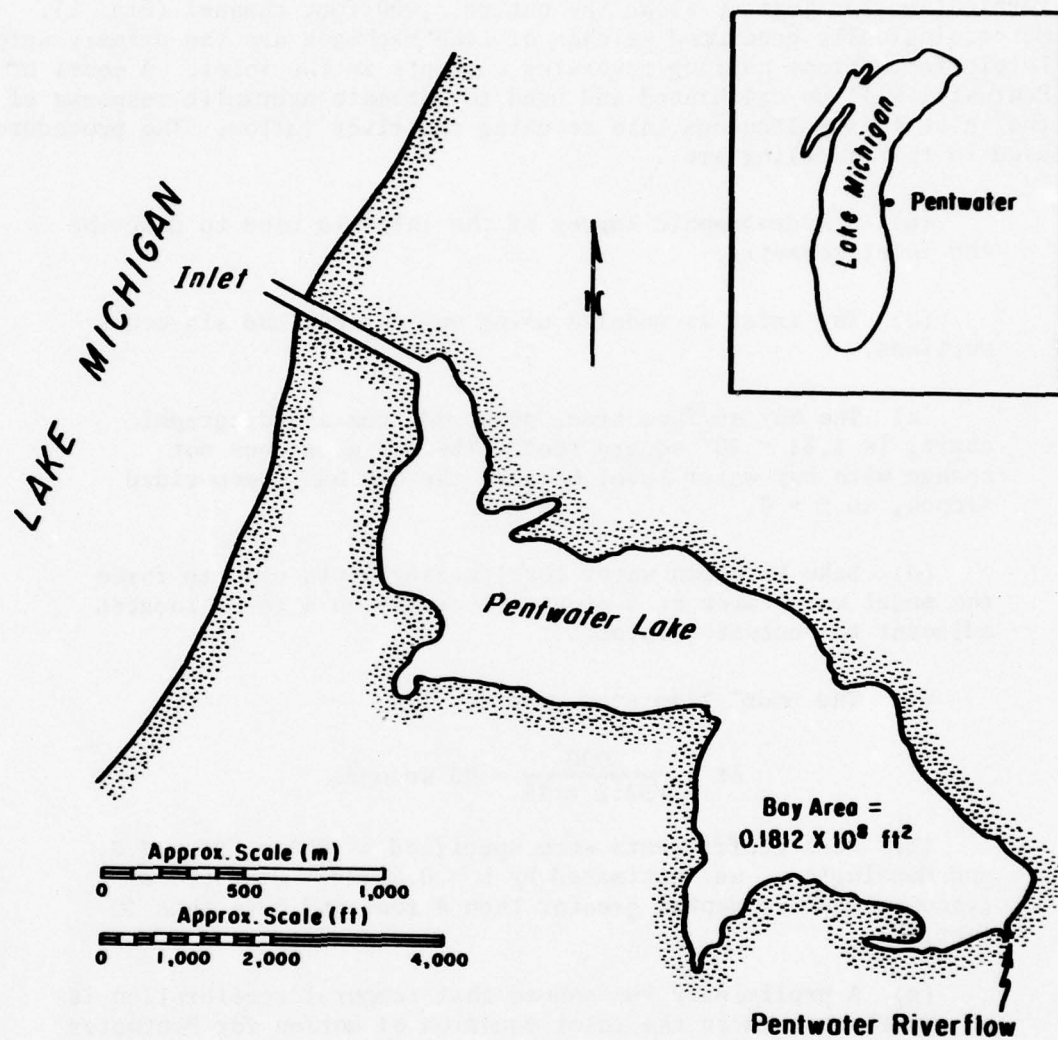


Figure 5. Pentwater Inlet, Michigan.

**Importance of Terms in the Equation of Motion  
(normalized by the largest term)**

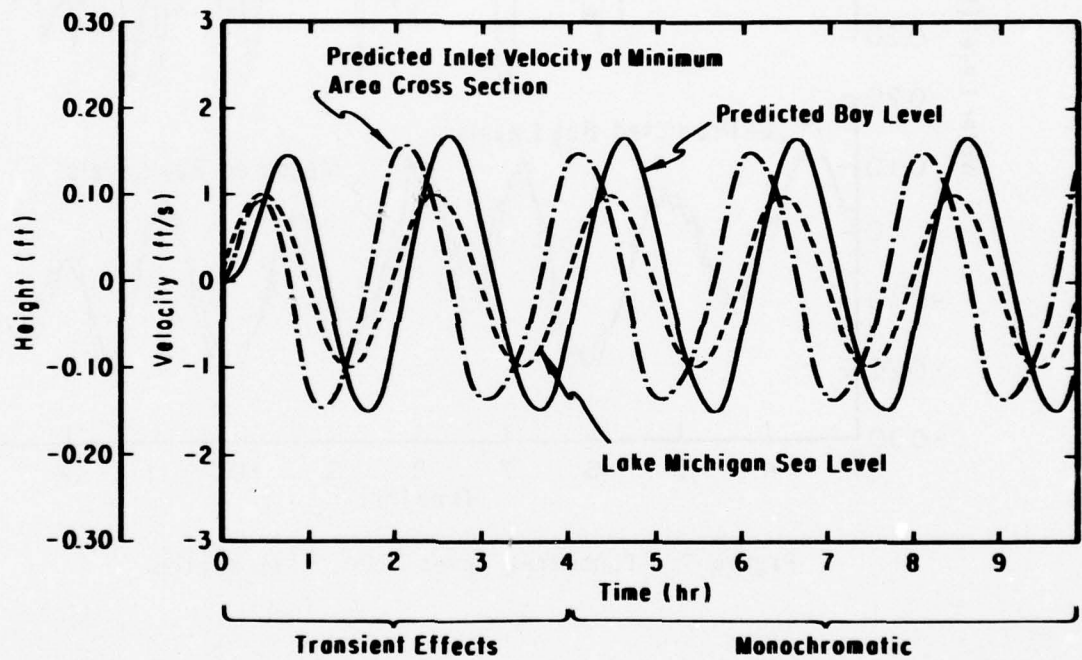
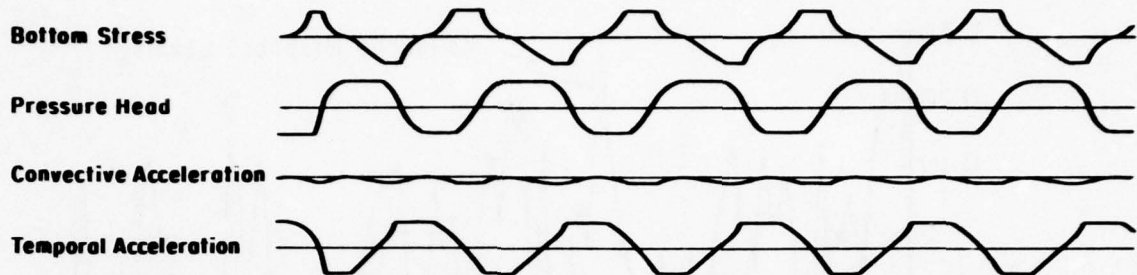


Figure 6. Pentwater Inlet model prediction of monochromatic forcing (for a 2-hour wave with a 9.1-foot amplitude).

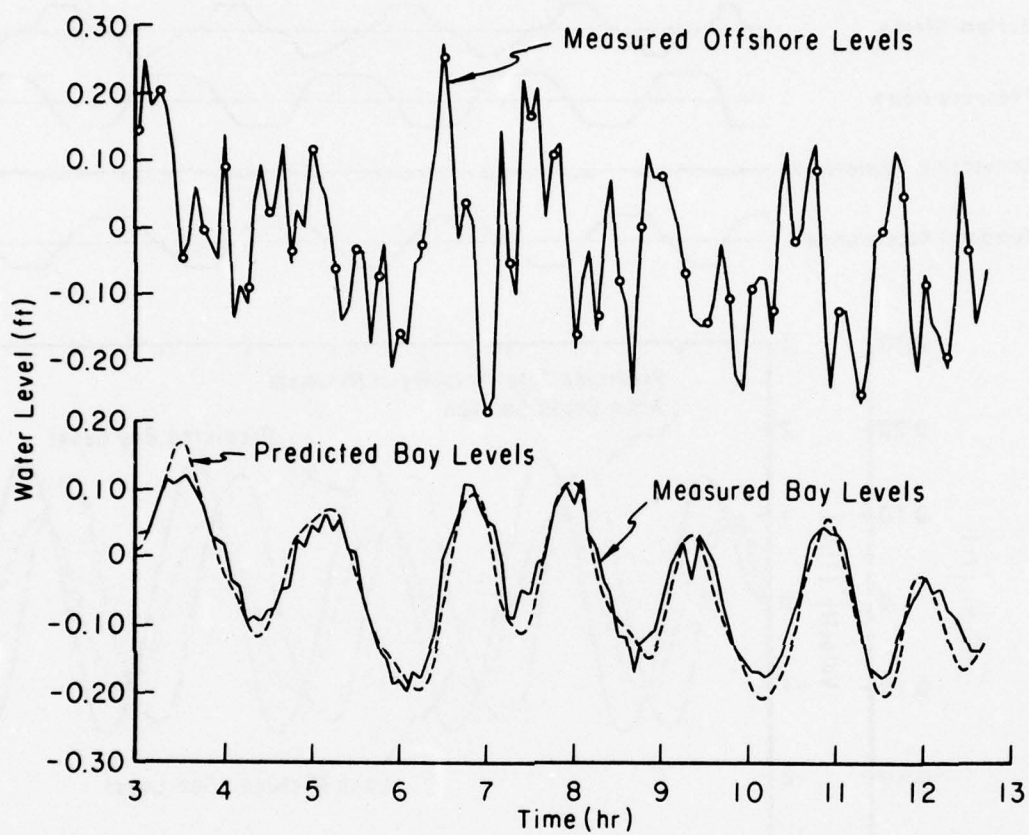


Figure 7. Pentwater Inlet model calibration.

amplitude of 0.10 foot and a discharge into Pentwater Lake of 2,800 cubic feet per second from the Pentwater River. The model predicted an average bay water surface elevation of 0.13 foot higher than the mean lake level, a bay water level fluctuation range of 0.25 foot, and a prism of water of  $4.6 \times 10^6$  cubic feet caused by the seiche (Fig. 8). The inlet would always be in ebb flow due to river influence with a maximum velocity of -2.7 feet per second and a minimum velocity of -0.1 foot per second. Head, friction, and temporal and convective acceleration are important in the inlet equation of motion.

#### IV. SUMMARY

A computer program (INLET) based on a numerical model (Seelig, Harris, and Herchenroder, in preparation, 1977)<sup>1</sup> is presented for prediction of hydraulics where one or more inlets connect a bay to a sea. Two examples are given: (a) A tidal inlet forced by an astronomical tide where inlet channel friction is the dominant term in the equation of motion; and (b) a Great Lakes inlet with river inflow forced by lake seiching where head, friction, and temporal and convective accelerations are important at different points in the water level fluctuation cycle. The model can also be used for forcing other water level fluctuations, such as from storm surges or tsunamis.

Another computer program (INLET2) is available for more complex systems of interconnected inlets, bays, and seas. INLET2 is an expanded version of INLET. Documentation and computer card decks for INLET2 are available from the Automatic Data Processing Division (CERDP), Coastal Engineering Research Center (CERC).

Details on model development and application, including additional examples, are reported by Seelig, Harris, and Herchenroder (in preparation, 1977)<sup>1</sup>.

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<sup>1</sup>SEELIG, HARRIS, and HERCHENRODER, op. cit., p. 7.

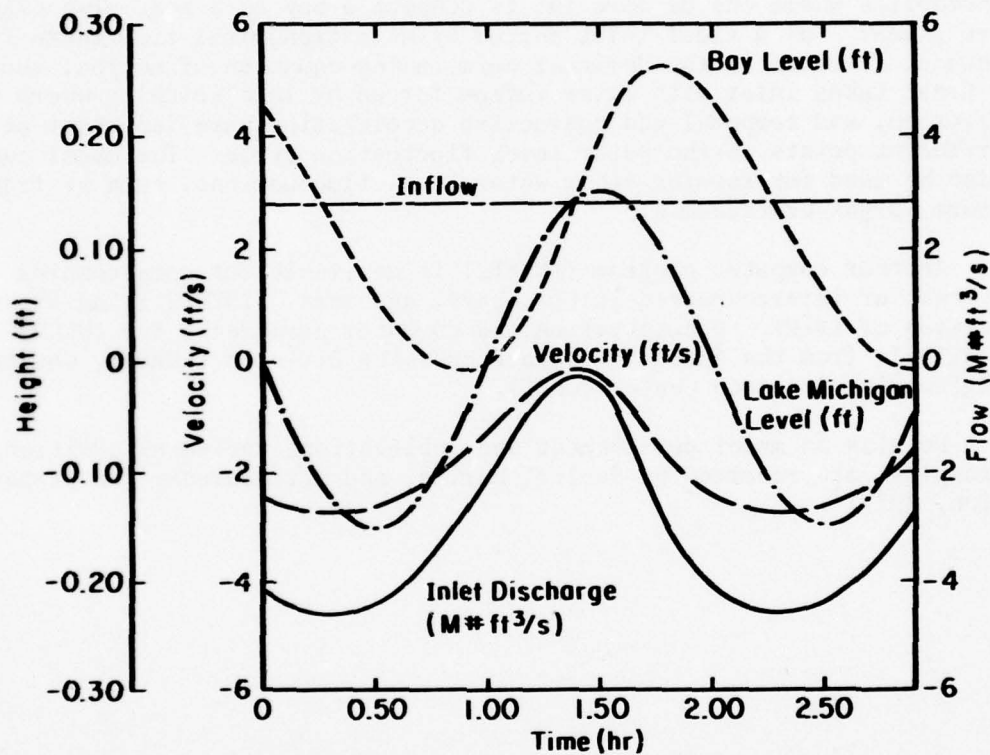
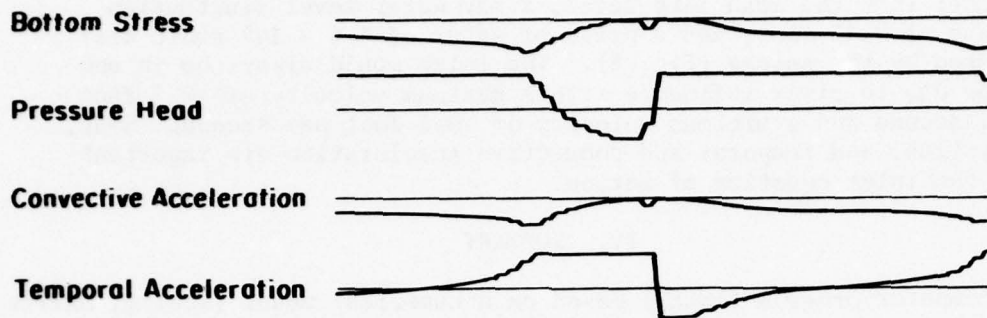


Figure 8. Predicted Pentwater Inlet velocities, discharge, bay levels, and relative magnitude of terms in the equation of motion.

## APPENDIX

### COMPUTER PROGRAM DOCUMENTATION (INLET)

#### 1. Program Description.

The numerical model to predict inlet hydraulics is programmed in FORTRAN for a CDC 6600 computer. The simultaneous differential equations are solved by a variable time step Runge-Kutta-Gill marching procedure. The organization of the computer program is shown in Figure A-1. A brief description of each routine follows:

INLET is the main routine which controls input-output and calls subroutines to execute a specific task. Figure A-1 summarizes control throughout the program. The program is organized to accept up to three inlets connecting the bay to the sea, up to seven channels for each inlet, and up to eight cross sections (seven grids long).

Subroutine HELM uses an iterative method of estimating the natural pumping period or Helmholtz period,  $T_H'$ , for the inlet-bay system by neglecting friction in the inlet to give:

$$T_H' = 2\pi \sqrt{\frac{(L_{in} + L') A_{bay}}{g A_c}}$$

where  $L'$  is added inlet length due to radiation, and where  $L$  is given by:

$$L' = \frac{-B}{\pi} \ln \left( \frac{\pi B}{\sqrt{gd} T_H} \right)$$

Subroutine RKGS is a routine to solve simultaneous differential equations. This subroutine was adapted from the scientific subroutine package.

Subroutine SETEQ evaluates the right-hand side of the equation of motion, one for each inlet, and the continuity equation between the inlet and bay for each step. This routine also evaluates the relative rank of the four terms in the equation of motion for flow in each inlet.

Subroutine LEVEL determines the water level in the grids at each time step. The routine interpolates the level between the sea and bay based on the relative amount of friction in each grid cell.

Subroutine TPWRTE writes hydraulic results from each time step on a tape or disc, so that this information can be used later by the output routines.

Subroutine TABLE outputs a table of instantaneous hydraulics each time the routine is called.

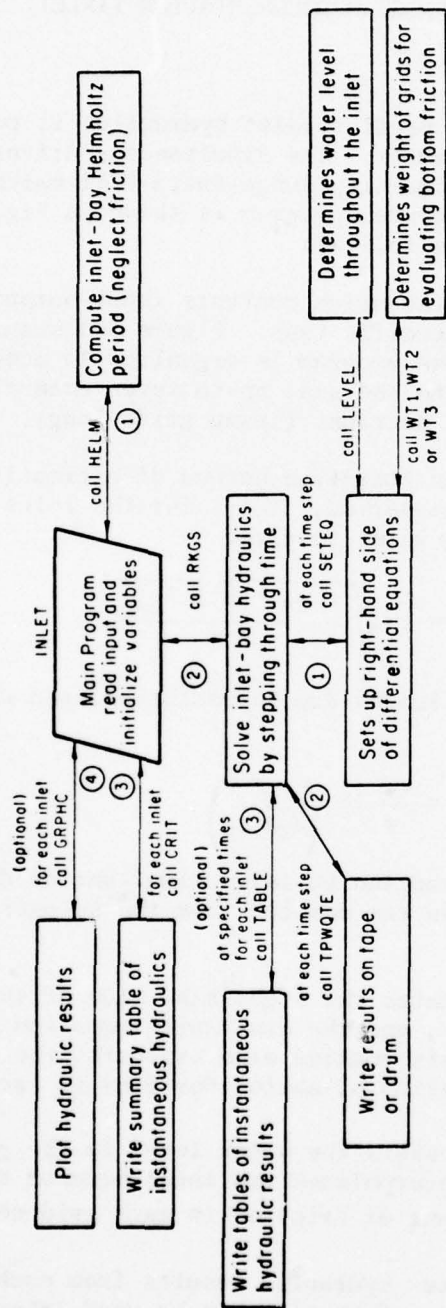


Figure A-1. Flow chart of the computer program INLET.

Subroutine SEA determines the water level in the sea as a function of time either for a given sine wave or by interpolating equal time-series data.

Subroutine WT1 determines the grid-weighting function by assuming that the flow is distributed across each section so that friction is minimized. This routine allows flow to cross channel boundaries, but assumes that this flow will be small, so the flow is neglected in the equation of motion. This weighting function is recommended for general use.

Subroutine WT2 is similar to WT1, except that flow is not allowed to cross channel boundaries and that flow is distributed in each channel so that friction is minimized.

Subroutine WT3 determines the weighting function so that flow is distributed equally in all grids. This is generally unrealistic, since it will be difficult to visually draw this grid system. However, this routine is useful since it provides an upper limit on frictional effects and therefore gives a lower limit of bay levels and inlet velocities. This weighting can be used to model simple geometry inlets where only one channel is used to represent the inlet.

Subroutine CRIT prints a table of critical instantaneous hydraulics (i.e., at high water, low water, maximum velocity, and maximum discharge). This table is determined by storing a summary of conditions for each time step, then scanning this list for critical values.

Subroutine GRPHC plots mean inlet hydraulics by scaling hydraulics in storage and plotting the time interval requested on a digital x-y pen plotter.

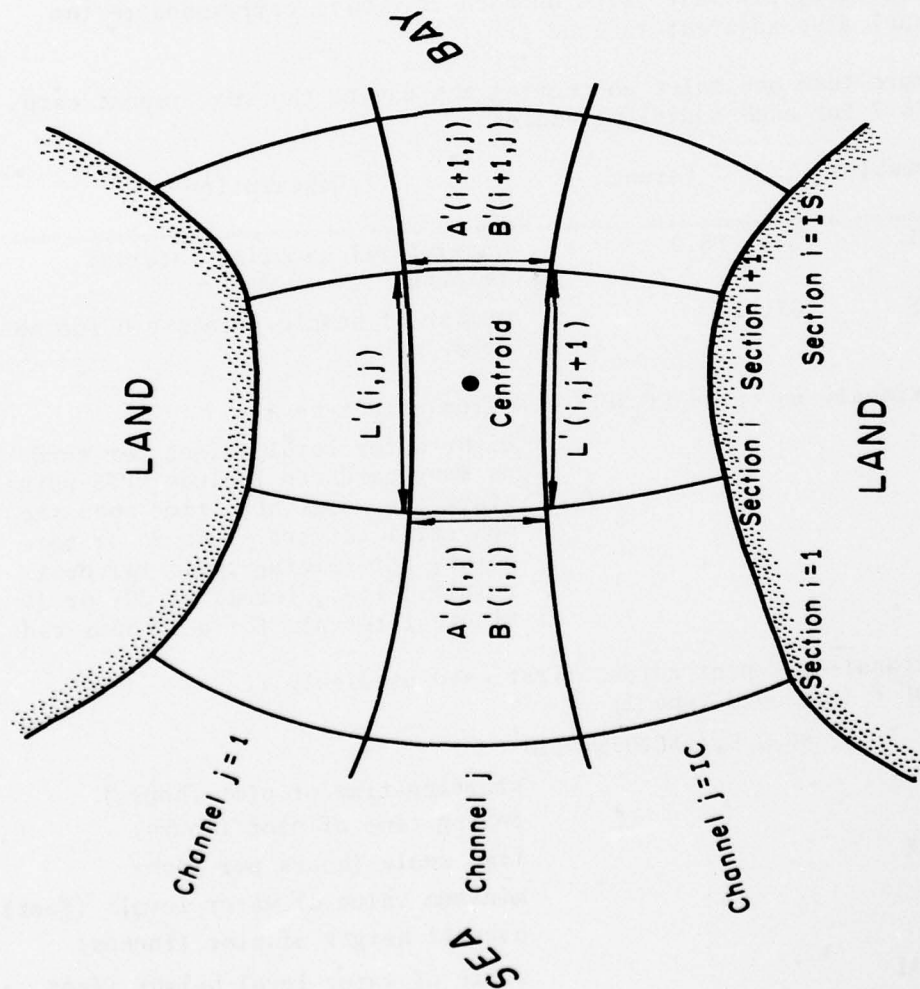
Subroutine READIN is used by GRPHC to read data in storage and scale values for plotting.

## 2. Program Input.

The computer program (INLET) requires the following input of one deck for each inlet-bay system:

Card type	Variables	Format	Description
1	ALABL1	4A10	first line of title
	ALABL2	4A10	second line of title
2		5I10, 2F10.5, I10	
	NINLET		number of inlets
	NCYCLES		number of cycles
	IPLLOT		IPLLOT = 1 for plot of results

Card type	Variables	Format	Description
	IWT		weighting type IWT = 1 flow distributed to minimize (1 in card col. 40)
	ITABLE		ITABLE = 1 for tables of instantaneous hydraulics
	C1, C2		Manning's n evaluated by: $n = C1 - C2 * D$ ; where D is still-water depth. If blank default values of C1 = 0.03777 and C2 = 0.000667 are assumed.
	ICONV		ICONV = 1 (1 in card col. 80)
3		3F10.5, E10.4, 3F10.5, 2F5.1	
	T		forcing period (hours)
	DELT		approximate time increment
	AO		forcing wave amplitude (feet)
	AB		bay area at datum (square feet)
	BETA		bay area variation parameter
	ZETA		inlet side slope $D(z)/D(y)$
	QINFLO		bay inflow from sources other than the inlet (cubic feet per second)
	CDF		an empirical flood-loss coefficient
	CDE		an empirical ebb-loss coefficient
4		2I10, F10.0	
	IC		number of channels
	IS		number of cross sections
	QINT		estimated inlet discharge at the time the model starts
5	(one card per section)	10X, 7F10.5	
	A'		cell cross-sectional areas at the ends of each cell at datum (square feet) (see Fig. A-2)
6	(one card per section)	10X, 7F10.5	
	B'		grid cell widths for the end of each cell (feet) (see Fig. A-2)



Cell characteristics

$$A(i,j) = \frac{A'(i,j) + A'(i+1,j)}{2}$$

$$B(i,j) = \frac{B'(i,j) + B'(i+1,j)}{2}$$

$$D(i,j) = A(i,j) / B(i,j)$$

$$L(i,j) = \frac{L'(i,j) + L'(i,j+1)}{2}$$

are applied at the cell centroid

Figure A-2. Cell input data.

Card type	Variables	Format	Description
7	(one less card than sections) L'	10X, 7F10.5	lengths of the sides of cells (see Fig. A-2) (one less card than number of sections; one more value per card than the number of channels)

For card types 5 to 7, there will be one card for each cross section of the inlet. The first card will be for the first cross section, i.e., the section closest to the sea, and the last section is adjacent to the bay. The first value on each card will correspond to the first channel adjacent to land; the last value on each card will correspond to the last channel also adjacent to land (Fig. A-2).

For more than one inlet connecting the bay to the sea, repeat card types 3 to 7 for each additional inlet.

Card type	Variables	Format	Description
8	TDEL  NPTS	34X, F6.2  6X, I3	water level sampling interval (minute)  number of sample points = 0 for no data
9	(optional--no cards if NPTS = 0 from card type 8) Y		eight water level values per card, as many cards to include NPTS points; start the model at a time when the sea level is zero. Use 25 or more points per forcing cycle for best results; i.e., levels at 30- or 15-minute intervals for a 12-hour tide.
10	(optional--two plot cards, first card used only if IPLOT = 1 on card type 1)  XO XF SCALX YLO YL YLSCAL	8F10.5,/,3F10.5, I10	starting time of plot (hours) ending time of plot (hours) time scale (hours per inch) minimum value of water levels (feet) overall height of plot (inches) scale of water level height (feet per inch)

Card type	Variables	Format	Description
	YRO		minimum flows (thousand cubic feet per second)
	YRSCAL		scale of flows (thousand cubic feet per second per inch)
Second card			
	YVO		minimum velocity (feet per second)
	YVSCAL		scale of velocities (feet per second per inch)
	SCALE		scale factor for total plot size
	IQ		IQ = 0 for no plot of inlet discharge
11	If a plot is requested, repeat card types 8 and 9 for observed bay levels to compare with predictions (card type 8 required; use NPTS = 0 for no observed bay levels). Only one set of card types 10 and 11 will be required for plotting even though the system modeled may have more than one inlet.		
12	End of file card.		

The inlet data for a computer run of Masonboro Inlet, North Carolina, are shown in Figure A-3.

### 3. Program Output.

The types of output include: (a) A summary table of grid dimensions, input parameters, and the Helmholtz period of the system estimated assuming there is no friction in the inlet; (b) (optional) summary tables of instantaneous inlet hydraulics; (c) (optional) a pen plot of inlet hydraulics; and (d) a table summarizing critical points throughout model operation, such as high water, low water, point of maximum discharge, and maximum velocity. Samples of input and output for the Masonboro Inlet run are given in Figures A-4, A-5, and A-6.

### 4. Computer Program.

A listing of the computer program (INLET) follows the sample output. The program was written in FORTRAN IV for a CDC 6600 computer with plotter. Control cards, plotting instructions, and file controls may have to be changed for other computers. If no plotter is available, the subroutine GRPHC and the call to the subroutine in the main program may be removed.

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```

MASONBORO 1000
CDF=2.
  25.0  1  200.  1  2.15  1  200000.00  2  0.2  1  0.  0.  2.  0.  1
A1  20200.  5510.  4570.  2420.
A2  0725.  7005.  5000.  2140.
A3  1000.  5050.  4025.  3700.
A4  000.  2425.  1000.  5200.
A5  000.  1030.  5070.  4000.
A6  1770.  4000.  4330.  3025.
A7  4000.  0010.  4000.  4000.
B1  3000.  000.  200.  00.
B2  1320.  1000.  310.  100.
B3  000.  1300.  200.  200.
B4  150.  030.  050.  500.
B5  200.  150.  200.  300.
B6  000.  000.  020.  000.
B7  000.  070.  070.  200.
L1  000.  000.  1000.  1000.  1000.
L2  750.  050.  1000.  1000.  1000.
L3  000.  550.  000.  1000.  1200.
L4  000.  700.  050.  000.  000.
L5  000.  000.  000.  000.  200.
L6  2000.  2100.  2100.  3000.  3000.
GAGE 0/12/00 MASONBORO DELT= 30. 0.00 50
-1.10 -1.00 -1.05 -1.00 -1.30 -0.00 -0.00 -0.00
0.30 0.00 1.20 1.70 2.00 2.33 2.00 2.50
2.01 2.22 1.01 1.50 1. 0.50 0. -0.50
-0.00 -1.12 -1.55 -1.02 -1.00 -1.00 -1.03 -0.09
-0.20 0.30 0.03 1.00 1.70 2.10 2.31 2.09
2.00 2.20 1.07 1.50 1.10 0.0 0.1 -0.0
-0.0 -1.3 2. -3. 0. 1. -0.0 20.
0. 22. 2.
-0. 2. 1.
NO DAY
EOR
  
```

Figure A-3. Sample of input data for a computer run of Masonboro Inlet, North Carolina.

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WAGONBOND 1969  
TEST

### CONTROL CARDS

25.00000	200.00000	2.15000	2.0000E+00	.20000	0.00000	0.00000	0.00000	2.0	0.0
----------	-----------	---------	------------	--------	---------	---------	---------	-----	-----

### SUMMARY OF INLET GRID CHARACTERISTICS

#### INLET NUMBER 1

**SECTION 1**

CHANNEL	1	2	3	4
ARFA(FP)	10002.5	0007.5	5124.0	2209.0
WIDTH(FP)	2100.0	100.0	200.0	05.0
DEPTH(FP)	0.00	0.00	17.00	20.00
LEN(FP)	875.0	050.0	1000.0	1000.0
4	.0310	.0335	.0250	.0210

## SECTION 2

	1	2	3	4
CNANVEL =				
AREA(F2)	6402.5	6767.5	5452.5	2920.0
=INT(F1)	918.0	1308.0	295.0	180.0
DEPTH(F1)	7.00	6.47	10.16	10.22
LEN(F1)	850.0	475.0	1000.0	1000.0
4	.0331	.0345	.0250	.0200

### SECTION 3

CHANNEL	1	2	3	4
AREA(FY)	2010.0	4087.5	7827.5	4092.5
INTM(FY)	425.0	905.0	364.0	400.0
DEPTM(FY)	4.73	4.52	21.45	11.73
LEV(FY)	405.0	725.0	974.0	1125.0
LF	.0346	.0340	.0235	.0303

**SECTION 4**

CHANGE	1	2	3	4
AREA(FY)	720.0	2780.5	7550.5	4002.5
%IDTM(FY)	315.0	207.0	365.0	445.0
DEPTM(FY)	2.20	9.50	20.70	10.52
LEN(FY)	600.0	775.0	175.0	900.0
N	.0362	.0314	.0260	.0300

## SECTION 5

CHANNEL #	1	2	3	4
AREA (FT <sup>2</sup> )	2135.0	4443.0	5204.5	4002.5
#IDTM (FT)	500.0	520.0	350.0	405.0
DEPTH (FT)	3.81	8.50	14.87	9.00
LEN (FT)	600.0	875.0	775.0	800.0
N	.0352	.0321	.0279	.0312

## SECTION 6

CHANNEL #	1	2	3	4
ARFA(FY)	4080.0	6230.0	6965.0	3902.5
WIDTH(FY)	910.0	750.0	545.0	300.0
DEPTH(FY)	4.88	7.94	12.00	11.11
LEN(FY)	2350.0	2130.0	2450.0	3500.0
M	.0348	.0324	.0290	.0308

FORCING PERIODS 25.00 HOURS

TMEL=(APPRC<sub>x</sub>)= 3.17 MBUS

TF/TMB 7.88

INLET LENGTH	ADDED LENGTH
1 4022.5	1749.4

TDEL. WYND 30.00 VPTS= 50

[illegible]

Figure A-4. Sample output from INLET (summary table for Masonboro Inlet input data).

# BEST AVAILABLE COPY

-----							
TIME: HOURS = 6.000 DELT. SEC = 400.00							
INLET 1							
SFA LEVEL+FT= 2.08							
RAV LEVEL+FT= 1.23							
DISCHARGE+CFS= .50011208							
DAY AREA= .2493E+09 FT2							
CHANNEL	SECTION 1	2	3	4	5	6	7 FRICTION
1	FRIC	.04	.06	.07	.42	.11	.31
1	LEVEL	2.08	2.08	2.06	1.70	1.32	1.26
1	V(FPS)	.12	.33	.04	2.14	.96	.53
1	Q(CFS)	2802.	2802.	2802.	2802.	2802.	2802.
1	WEIGHT	.05	.05	.05	.05	.05	.05
1	FRIC	.00	.00	.00	.10	.01	.01
2	LEVEL	2.06	2.02	1.94	1.66	1.39	1.29
2	V(FPS)	1.01	.93	1.52	2.71	1.73	1.24
2	Q(CFS)	8993.	8993.	8993.	8993.	8993.	8993.
2	WEIGHT	.16	.16	.16	.16	.16	.16
2	FRIC	.01	.01	.02	.10	.02	.03
3	LEVEL	2.06	2.00	1.95	1.83	1.67	1.42
3	V(FPS)	5.40	4.94	3.63	3.77	5.35	4.07
3	Q(CFS)	31238.	31238.	31238.	31238.	31238.	31238.
3	WEIGHT	.57	.57	.57	.57	.57	.57
3	FRIC	.03	.03	.02	.11	.07	.20
4	LEVEL	2.07	2.04	1.98	1.75	1.54	1.37
4	V(FPS)	4.60	3.50	2.20	2.13	2.52	2.62
4	Q(CFS)	11772.	11772.	11772.	11772.	11772.	11772.
4	WEIGHT	.21	.21	.21	.21	.21	.21
4	FRIC	.00	.01	.02	.10	.01	.08
TEMP ACC= .6 CONV ACC= 32.4 HEAD= 100.0 FRIC= 67.0							
MEAN VELOCITY AT THE MINIMUM AREA SECTION= 2.97 FT/SEC AWTN= 18.29.73 FT2							
-----							

Figure A-5. Sample output from INLET (summary table of instantaneous hydraulics for Masonboro after 6 hours of model time).

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SUMMARY TABLE OF HYDRAULICS INLET 1					
TIME HRS	HS FT	INFLW KCFS	HH FT	VEL FPS	Q KCFS
.334	-1.500	0.000	-.239	-3.861*	-55.100*
1.056	-1.650*	0.000	-.451	-2.919	-39.568
2.167	-1.303	0.000	-1.562*	.053	.683
3.434	.155	0.000	-.541	2.463*	37.947
3.945	.245	0.000	-.456	2.491*	38.631
5.167	1.384	0.000	.516	2.922*	50.286
5.389	1.568	0.000	.698	2.940*	51.646
5.500	1.654	0.000	.788	2.945*	52.193
5.611	1.744	0.000	.878	2.946*	52.656
5.723	1.834	0.000	.967	2.957*	53.252
5.834	1.922	0.000	1.056	2.968*	53.884
5.945	2.009	0.000	1.145	2.976*	54.441
6.056	2.090	0.000	1.234	2.974*	54.806
6.167	2.140	0.000	1.321	2.958*	54.889*
7.389	2.506*	0.000	2.147	2.154	41.977
8.389	2.296	0.000	2.462*	.086	1.714
10.611	.444	0.000	1.191	-3.308	-55.734*
10.667	.389	0.000	1.146	-3.337*	-55.713
10.778	.278	0.000	1.055	-3.362*	-55.607
10.889	.166	0.000	.962	-3.382*	-55.425
11.000	.055	0.000	.864	-3.398*	-55.177
11.111	-.054	0.000	.774	-3.411*	-54.870
11.223	-.164	0.000	.679	-3.422*	-54.519
11.334	-.279	0.000	.582	-3.429*	-54.126
11.445	-.391	0.000	.485	-3.433*	-53.680
11.556	-.500	0.000	.387	-3.433*	-53.170
11.667	-.611	0.000	.288	-3.430*	-52.606
11.778	-.723	0.000	.188	-3.427*	-52.037
11.889	-.831	0.000	.087	-3.420*	-51.412
12.000	-.933	0.000	-.014	-3.403*	-50.657
13.723	-1.625*	0.000	-1.418	-1.764	-22.758
14.445	-1.445	0.000	-1.605*	-.073	-.923
15.389	-.812	0.000	-1.245	1.880*	25.949
17.278	1.153	0.000	.185	2.994*	50.979
17.389	1.257	0.000	.283	3.020*	52.008
17.500	1.354	0.000	.382	3.036*	52.865
17.667	1.484	0.000	.526	3.089*	53.680*
17.778	1.559	0.000	.625	3.002*	53.685
17.834	1.595	0.000	.722	3.004	53.720*
17.889	1.630	0.000	.719	3.033*	53.719
18.056	1.740	0.000	.858	2.994	53.442*
18.111	1.780	0.000	.904	2.973*	53.468
18.223	1.864	0.000	.994	2.965*	53.749
18.334	1.949	0.000	1.083	2.967*	54.204
18.445	2.030	0.000	1.172	2.969*	54.648
18.556	2.100	0.000	1.260	2.962	54.883*
19.778	2.508*	0.000	2.099	2.267	44.163
20.723	2.196	0.000	2.416*	-.016	-.312
21.778	1.390	0.000	1.904	-2.904*	-52.626*
21.889	1.305	0.000	1.827	-2.921*	-52.545
22.000	1.211	0.000	1.750	-2.942	-52.477*
22.778	.373	0.000	1.157	-3.394*	-56.639*
22.889	.264	0.000	1.064	-3.415*	-56.478
23.000	.155	0.000	.970	-3.429*	-56.184
23.111	.044	0.000	.876	-3.440*	-55.836
23.223	-.067	0.000	.780	-3.449*	-55.460
23.334	-.178	0.000	.684	-3.456*	-55.044
23.445	-.289	0.000	.587	-3.459*	-54.588
23.556	-.400	0.000	.489	-3.461*	-54.092
23.667	-.513	0.000	.390	-3.461*	-53.574
23.778	-.628	0.000	.290	-3.463*	-53.063
23.889	-.741	0.000	.189	-3.462*	-52.518
24.000	-.849	0.000	.087	-3.454*	-51.870
24.111	-.951	0.000	-.015	-3.435*	-51.063
24.223	-1.052	0.000	-.117	-3.409*	-50.167
25.000	-1.390*	0.000	-.855	-2.599	-35.948

\* CRITICAL POINT VALUE

Figure A-6. Sample output from INLET (table of critical points for the model time: high water, low water, etc., for Masonboro Inlet).

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## Listing of the computer program INLET.

```

PROGRAM INLET(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE9,TAPE10, INLET 2
1 TAPE3,PUNCH=TAPE3) INLET 3
C PROGRAM NUMBER 720&R1650 (INLET) ANALYSES AND PREDICTS INSTANTANEOUS INL INLET 4
C HYDRAULICS USING A LUMPED PARAMETER SCHEME (SEE SFELIG, HARRIS AND INLET 5
C HENCHENRODER, 1976. (A GENERALIZED LUMPED PARAMETER MODEL OF INLET INLET 6
C HYDRAULICS), A DRAFT CERC REPORT) INLET 7
REAL L,LENGTH,LINOLEX,M,NX INLET 8
COMMON/NUMS/NI,GINLET,ICH(3),ISF(3),OR,L(7,7),B(7,7),D(7,7), INLET 9
1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),MS,MH,N(7,7),IC,IS,AMINI(3), INLET 10
10MINI(3),L1,OX(3),QINFLO,ARAY,LENGTH(3) INLET 11
COMMON/NUM1/V(5),DERV(5),X,INT,INT,ZETA,MH INLET 12
COMMON/NUM2/DX(3,7,7),DX(3,7,7),MX(3,7,7),MX(3,7,7),LX(3,7,7),MX(3 INLET 13
1,7,7) INLET 14
COMMON /NUM3/AB,TAAR,RETA INLET 15
COMMON/NUM4/RNR(3,4) INLET 16
DIMENSION CORL(3) INLET 17
DIMENSION ALABL1(4),ALABL2(4),IDUF(1000),NUMBER(20) INLET 18
3370 CONTINUE INLET 19
DO 2193 I=1,3 INLET 20
2193 GR(I)=1. INLET 21
C GO ACCELERATION OF GRAVITY INLET 22
G=32.2 INLET 23
DO 1211 I=1,20 INLET 24
1211 NUMBER(I)=1 INLET 25
WRITE(6,2037) INLET 26
2037 FORMAT(//,1X,('-----')) INLET 27
READ(5,1167) (ALABL1(I),I=1,4) INLET 28
READ(5,1167) (ALABL2(I),I=1,4) INLET 29
1167 FORMAT(AA10) INLET 30
WRITE(6,1168) (ALABL1(I),I=1,4) INLET 31
WRITE(6,1168) (ALABL2(I),I=1,4) INLET 32
1168 FORMAT(XX,AA10) INLET 33
WRITE(6,1268) INLET 34
1268 FORMAT(/,5X,('CONTROL CARDS')) INLET 35
C HEAD CONTROL CARDS INLET 36
C INLET 37
READ(5,1011) MINLET,NCYCLES,IPLOT,INT,ITABLE,C1,C2 INLET 38
WRITE(6,1012) MINLET,NCYCLES,IPLOT,INT,ITABLE,C1,C2 INLET 39
1011 FORMAT(5I10,2F10,5) INLET 40
1012 FORMAT(1X,5I10,2F10,5) INLET 41
C MINLET=THE NUMBER OF INLETS INLET 42
C NCYCLES= NUMBER OF TIDAL CYCLES INLET 43
C IPLOT (1 FOR A PLOT OF MEAN HYDRAULICS, 0 FOR NO PLOT) INLET 44
C INT IS A PARAMETER DESCRIBING THE TYPE OF FIGHTING DESIRED INLET 45
C INT=1 FOR FLOW WEIGHTING TO ACHIEVE MINIMUM FRICTION INLET 46
C INT=2 FOR WEIGHTING FOR MINIMUM FRICTION WITH NO FLOW ACROSS CHANNELS INLET 47
C INT=3 FOR EQUAL FLOW IN ALL GRIDS TO GIVE MAXIMUM FRICTION INLET 48
C ITABLE=1 FOR A TABLE OF OUTPUT INLET 49
C C1,C2 =C1-C2 * D. IF C1 AND C2 ARE ZERO THE MASCH VALUES OF INLET 50
C C1 =.03777 AND C2=.000667 ARE USED INLET 51
IF(C1.EQ.0.0.AND,C2.EQ.0.0) C2= 0.000667 INLET 52
IF(C1.EQ.0.) C1=.03777 INLET 53
C INLET 54

```

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1	FORMAT(A110)	INLET	55
	READ(5,111) T,DELTA,AD,AB,BETA,ZETA,QINFLO	INLET	56
	WRITE(6,111) T,DELTA,AD,AB,BETA,ZETA,QINFLO	INLET	57
111	FORMAT(3F10.5,E10.4,4F10.5)	INLET	58
C	T=TIDAL PERIOD, HRS (LATER CONVERTED TO SECONDS)	INLET	59
C	DELTA=ESTIMATED TIME STEP, SEC	INLET	60
C	AD=SFA TIDAL AMPLITUDE, FT	INLET	61
C	AB=DAY AREA AT THE DATUM, SQUARE FEET	INLET	62
C	BETA=HAY AREA VARIATION PARAMETER (D(AB)/D(HB))	INLET	63
C	ZETA=CHANNEL SLOPE (D(Y)/D(X))	INLET	64
C	QINFLO=INFLOW INTO THE BAY FROM OTHER SOURCES (FT <sup>3</sup> /SEC)	INLET	65
C		INLET	66
	END=T*NCYCLES*3600.	INLET	67
	IF(ZETA,LE,0.)ZETA=1./E25	INLET	68
	AT=0	INLET	69
C		INLET	70
C	READ IN INFORMATION OF EACH INLET	INLET	71
	DO 1110 NI=1,NINLET	INLET	72
	IUNIT=8+NI	INLET	73
	RE=10 IUNIT	INLET	74
	READ(5,1) IC,IS	INLET	75
C	IC=NUMBER OF CHANNELS	INLET	76
C	IS=NUMBER OF INLET CROSS-SECTIONS	INLET	77
	IF(IC,GT,7,OR,IS,GT,7) WRITE(6,1671)	INLET	78
1671	FORMAT(///,5X,('***' 100 MANY GRIDS FOR DIMENSIONS(,)))	INLET	79
	ICM(NI)=IC	INLET	80
C	READ SECTION AREAS (ONE CARD PER SECTION)	INLET	81
	DO 5 I=1,IS	INLET	82
5	READ(5,2) (A(I,J),J=1,IC)	INLET	83
2	FORMAT(10X,7F10,5)	INLET	84
C		INLET	85
C	READ SECTION WIDTHS (ONE CARD PER SECTION)	INLET	86
	DO 6 I=1,IS	INLET	87
6	READ(5,2) (H(I,J),J=1,IC)	INLET	88
C		INLET	89
	ICP1=IC+1	INLET	90
	ISM1=IS-1	INLET	91
C	READ LENGTHS (ONE MORE LENGTH PER CARD THAN CHANNELS)	INLET	92
C	(ONE LESS CARD THAN THE NUMBER OF SECTIONS)	INLET	93
	DO 7 I=1,ISM1	INLET	94
7	READ(5,2) (L(I,J),J=1,ICP1)	INLET	95
C		INLET	96
C	INITIALIZE VARIABLES TO BEGIN ITERATION	INLET	97
C	NUMBER OF GRIDS ALONG THE CHANNEL IS ONE LESS THAN THE NUMBER OF	INLET	98
C	CROSS-SECTIONS	INLET	99
88	IS=IS-1	INLET	100
	ISE(NI)=IS	INLET	101
	ISM1=IS-1	INLET	102
	WRITE(6,3678) NI	INLET	103
3678	FORMAT( /,5X,(SUMMARY OF INLET GRID CHARACTERISTICS(,))	INLET	104
	1 15X,(INLET NUMBER(,IS)	INLET	105
	WRITE(6,1) IC,IS	INLET	106
	DO 10 I=1,IS	INLET	107

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DO 11 J=1,IC
  LENGTH(NI)=LENGTH(NT)*L(I,J)/FLOAT(IC)
  A(I,J)=(A(I,J)+A(I+1,J))/2.
  L(I,J)=(L(I,J)+L(I+1,J))/2.
  H(I,J)=(H(I,J)+H(I+1,J))/2.
  D(I,J)=(D(I,J)+D(I+1,J))/2.
  N(I,J)=C1-C2*D(I,J)
  LX(NI+1,J)=L(I,J)
  HX(NI+1,J)=H(I,J)
  DX(NI+1,J)=D(I,J)
  NX(NI+1,J)=N(I,J)
  AX(NI+1,J)=1./FLOAT(IC)
11 CONTINUE
  WRITE(6,1207) I
1207 FORMAT(/,1X,(SECTION),13)
  WRITE(6,1221) (NUMBER(I),I=1,IC)
1221 FORMAT(5X,(CHANNEL #),10I10,/)
C PRINT A SUMMARY TABLE OF GEOMETRIES
  WRITE(6,1971) (A(I,J),J=1,IC)
  WRITE(6,1972) (H(I,J),J=1,IC)
  WRITE(6,1973) (D(I,J),J=1,IC)
  WRITE(6,1974) (L(I,J),J=1,IC)
  WRITE(6,1975) (N(I,J),J=1,IC)
1971 FORMAT(5X,(AREA(FT2)),10F10,1)
1972 FORMAT(5X,(WIDTH(FT)),10F10,1)
1973 FORMAT(5X,(DEPTH(FT)),1X,10F10,2)
1974 FORMAT(5X,(LEN(FT)),2X,10F10,1)
1975 FORMAT(5X,(N(10X,10F10,4))
10 CONTINUE
C FIND AREA AND WIDTH AT THE MINIMUM SECTION
  AMINI(NI)=99.E+12
  DO 109 I=1,18
    AAA=0.
    BBB=0.
    DO 108 J=1,IC
      AAA=AAA+A(I,J)
      BBB=BBB+H(I,J)
108 HHH=HHH+H(I,J)
      IF(AAA.GT.AMINI(NI)) GO TO 109
      AMINI(NI)=AAA
      HMINI(NI)=BBB
109 CONTINUE
1110 CONTINUE
C ESTIMATE THE INLET-RAV HELMHOLTZ PERIOD
  CALL HELM(THELM,AA,CORL)
  THTF=THELM
  WRITE(6,201) T,THFLM,THTF
201 FORMAT(1X,(FORCING PERIOD=),F7,2,( HOURS),
  1/,1X,(THELM(APPROX)=),F8,2,( HOURS),/
  1 1X,(TH/THM=),10X,F6,2)
  WRITE(6,1337) ((J,LENGTH(J),CORL(J)),J=1,NINLET)
1337 FORMAT( 1X,(INLET LENGTH ADDED LENGTH(, (/),4X,12,1X,
  1 F6,1,2X,F6,1))
  T=T+3600.
  CALL MKGS(END,DELT,NINLET,QINFLO,ITABLE,T)
  DELT=END/FLOAT(NT)
  DO 2269 NI=1,NINLET
    HHH=0.
  WRITE(6,2269) NI
2269 FORMAT(/,10X,(SUMMARY TABLE OF HYDRAULICS INLET(,15)
  1UNIT=NI+A
  CALL CRIT(NT,DELT,UNIT,T,NCYCLES)
  IF(TPLOT.EQ.1.AND.NI.EQ.1) CALL PLOTS(IRUF,1000,3)
  IF(TPLOT.EQ.1) CALL GRPMC(ALAHL1,ALAHL2,DELT,UNIT,NI)
  IF(TPLOT.EQ.1.AND.NI.FQ,NINLET) CALL PLOT(0.,0.,999)
2269 CONTINUE
  STOP
  END

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SUBROUTINE RKGS(END,DFLT,NINLET,GINFLO,ITABLE,T)	INLET	175
C ROUTINE TO SOLVE A SET OF SIMULTANEOUS DIFFERENTIAL EQUATIONS	INLET	176
C ADAPTED FROM SCIENTIFIC SUBROUTINE PACKAGE, IBM, 1970	INLET	177
COMMON/NUM1/Y(5),DERV(5),X,NT,INT,ZETA,HS	INLET	178
COMMON/NUM4/RNK(3,4)	INLET	179
DIMENSION AUX(8,5),A(8),B(8),C(8),PRMT(5),AMINI(3)	INLET	180
NDIM=NINLET+1	INLET	181
PRMT(1) = 1.	INLET	182
PRMT(2)=END	INLET	183
PRMT(3)=DELT	INLET	184
PRMT(4) = .1	INLET	185
IF(T,GT,36000.) DELTH=3600.	INLET	186
IF(T,LE,36000.) DFLTH=T/9.	INLET	187
DO 1122 JN=1,NINLET	INLET	188
Y(JN)=0.01	INLET	189
1122 DERV(JN)=0.001	INLET	190
Y(NDIM)=0.	INLET	191
DERV(NDIM)=1.0-FL0AT(NINLET)*0.001	INLET	192
DO 1 I=1,NDIM	INLET	193
1 AUX(8,I)=0.066666667*DERV(I)	INLET	194
X=PRMT(1)	INLET	195
XEND=PRMT(2)	INLET	196
H=PRMT(3)	INLET	197
PRMT(5)=0.	INLET	198
CALL SFTEQ(AMINT)	INLET	199
IF(H*(XEND-X))3A,37,2	INLET	200
2 CONTINUE	INLET	201
A(1)=0.5	INLET	202
A(2)=0.2928932	INLET	203
A(3)=1.707107	INLET	204
A(4)=0.16666667	INLET	205
B(1)=2.	INLET	206
B(2)=1.	INLET	207
B(3)=1.	INLET	208
B(4)=2.	INLET	209
C(1)=0.5	INLET	210
C(2)=0.2928932	INLET	211
C(3)=1.707107	INLET	212
C(4)=0.5	INLET	213
DO 3 I=1,NDIM	INLET	214
AUX(1,I)=Y(I)	INLET	215
AUX(2,I)=DERV(I)	INLET	216
AUX(3,I)=0.	INLET	217
3 AUX(6,I)=0.	INLET	218
IFEC=0	INLET	219
H=H+H	INLET	220
IMLF=1	INLET	221
ISTEP=0	INLET	222
IFND=0	INLET	223
4 CONTINUE	INLET	224
IF((X+H=XEND)*H)7,6,5	INLET	225
5 CONTINUE	INLET	226
6 CONTINUE	INLET	227

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M=XEND=X	INLET	228
IEND=1	INLET	229
7 CONTINUE	INLET	230
CALL SFA(MS,X)	INLET	231
CALL TPRWTE(NINLET,X,MS,QINFLO,Y,AMINI,RNK,NT)	INLET	232
IFLAG1=X/DELTB	INLET	233
IF((IFLAG1.NE.IFLAG2.AND.1TABLE.EQ.1)) CALL TABLE	INLET	234
IFLAG2=IFLAG1	INLET	235
IF(PRMT(5))40.8,40	INLET	236
8 CONTINUE	INLET	237
ITEST=0	INLET	238
9 CONTINUE	INLET	239
ISTEP=ISTEP+1	INLET	240
J=1	INLET	241
10 CONTINUE	INLET	242
AJ=A(J)	INLET	243
HJ=B(J)	INLET	244
CJ=C(J)	INLET	245
DO 11 I=1,NDIM	INLET	246
R1=H*DERV(I)	INLET	247
R2=AJ*(R1+HJ*AUX(6,I))	INLET	248
Y(I)=Y(I)+R2	INLET	249
R2=R2+HJ+H2	INLET	250
11 AUX(6,I)=AUX(6,I)+R2+CJ*R1	INLET	251
IF(J=4)12,15,15	INLET	252
12 CONTINUE	INLET	253
J=J+1	INLET	254
IF(J=3)13,14,13	INLET	255
13 CONTINUE	INLET	256
X=X+0.5*M	INLET	257
14 CONTINUE	INLET	258
CALL SETEQ(AMINT)	INLET	259
GO TO 10	INLET	260
15 CONTINUE	INLET	261
IF(ITEST)16,16,20	INLET	262
16 CONTINUE	INLET	263
DO 17 I=1,NDIM	INLET	264
AUX(4,I)=Y(I)	INLET	265
ITEST=1	INLET	266
ISTEP=ISTEP+ISTEP=2	INLET	267
18 CONTINUE	INLET	268
IMLF=IMLF+1	INLET	269
X=X+M	INLET	270
M=0.5*M	INLET	271
DO 19 I=1,NDIM	INLET	272
Y(I)=AUX(1,I)	INLET	273
DERV(I)=AUX(2,I)	INLET	274
19 AUX(6,I)=AUX(3,I)	INLET	275
GO TO 9	INLET	276
20 CONTINUE	INLET	277
IMOD=ISTEP/2	INLET	278
IF(ISTEP=IMOD=IMOD)21,23,21	INLET	279
21 CONTINUE	INLET	280

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CALL SETEQ(AMINT)	INLET	281
DO 22 I=1,NDIM	INLET	282
AUX(5,I)=Y(I)	INLET	283
22 AUX(7,I)=DERV(I)	INLET	284
GO TO 9	INLET	285
23 CONTINUE	INLET	286
DELT=0.	INLET	287
DO 24 I=1,NDIM	INLET	288
24 DELT=DELT+AUX(8,I)*ABS(AUX(4,I)-Y(I))	INLET	289
IF(DELT=PRMT(4))28,28,25	INLET	290
25 CONTINUE	INLET	291
IF(IHLF=10)26,36,36	INLET	292
26 CONTINUE	INLET	293
DO 27 I=1,NDIM	INLET	294
27 AUX(4,I)=AUX(5,I)	INLET	295
ISTEP=ISTEP+ISTEP=4	INLET	296
X=X+H	INLET	297
IEND=0	INLET	298
GO TO 14	INLET	299
28 CONTINUE	INLET	300
CALL SETEQ(AMINT)	INLET	301
DO 29 I=1,NDIM	INLET	302
AUX(1,I)=Y(I)	INLET	303
AUX(2,I)=DERV(I)	INLET	304
AUX(3,I)=AUX(6,I)	INLET	305
Y(I)=AUX(5,I)	INLET	306
29 DERV(I)=AUX(7,I)	INLET	307
CALL SEA(MS,X=H)	INLET	308
CALL TPWTF(NINLET,X=H,MS,QINFLO,Y,AMINT,RNK,NT)	INLET	309
IFLAG1=(X=H)/DELT8	INLET	310
IF(TFLAG1.NF,IFLAG2.AND,ITABLE.EQ,1) CALL TABLE	INLET	311
IFLAG2=IFLAG1	INLET	312
IF(PRMT(5))40,30,40	INLET	313
30 CONTINUE	INLET	314
DO 31 I=1,NDIM	INLET	315
Y(I)=AUX(1,I)	INLET	316
31 DERV(I)=AUX(2,I)	INLET	317
IHLF=IHLF	INLET	318
IF(IEND)32,32,39	INLET	319
32 CONTINUE	INLET	320
IHLF=IHLF+1	INLET	321
ISTEP=ISTEP/2	INLET	322
H=H*H	INLET	323
IF(IHLF)4,33,33	INLET	324
33 CONTINUE	INLET	325
IMOD=ISTEP/2	INLET	326
IF(ISTEP=IMOD=IMOD)4,34,4	INLET	327
34 CONTINUE	INLET	328
IF(DELT=0.02*PRMT(4))35,35,4	INLET	329
35 CONTINUE	INLET	330
IHLF=IHLF+1	INLET	331
ISTEP=ISTEP/2	INLET	332
H=H*H	INLET	333
GO TO 4	INLET	334
36 CONTINUE	INLET	335
IHLF=11	INLET	336
CALL SETEQ(AMINT)	INLET	337
GO TO 39	INLET	338
37 CONTINUE	INLET	339
IHLF=12	INLET	340
GO TO 39	INLET	341
38 CONTINUE	INLET	342
IHLF=13	INLET	343
39 CONTINUE	INLET	344
CALL SEA(MS,X)	INLET	345
CALL TPWTF(NINLET,X=H,MS,QINFLO,Y,AMINT,RNK,NT)	INLET	346
IFLAG1=X/DELT8	INLET	347
IF(TFLAG1.NF,IFLAG2.AND,ITABLE.EQ,1) CALL TABLE	INLET	348
IFLAG2=IFLAG1	INLET	349
40 CONTINUE	INLET	350
RETURN	INLET	351
END	INLET	352

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SUBROUTINE SETEQ(AMIN)
C ROUTINE TO SETUP THE EQUATIONS FOR THE RIGHT HAND SIDE OF THE EQUATIONS
C MOTION AND TO DETERMINE THE RANK OF THE TERMS IN THE EQUATION OF MOTIO
REAL L,LENGTH,LIN,LX,N,NX,LF
COMMON/NUM5/NI,G,NINLET,ICH(3),ISE(3),GR,L(7,7),B(7,7),D(7,7),
1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),HS,HB,H(7,7),IC,IS,AMINI(3),
1HMINI(3),LIN,QX(3),QINFLO,ARRAY,LENGTH(3)
COMMON/NUM1/Y(5),DFRY(5),X,NT,INT,ZETA,HH
COMMON/NUM2/BX(3,7,7),DX(3,7,7),MX(3,7,7),WX(3,7,7),LX(3,7,7),NX(3
1,7,7)
COMMON /NUM3/AO,T,ARY,BETA
COMMON/NUM4/RNK(3,4)
DIMENSION AMIN(3)
G=32.2
DO 220 NI=1,3
DO 119 I=1,4
119 RNK(NI,I)=0.
220 CONTINUE
CALL SEA(HS,X)
H=HS
C FIND THE HAY AREA
HHRV(NINLET+1)
AHAY=ABV*(1.+BETA*HR)
QT=0.
C SET UP EQUATIONS FOR EACH INLET
DO 100 NI=1,NINLET
AMIN(NI)=999999999999.
GRV(NI)
QT=QT+QT
IC=ICH(NI)
IS=ISE(NI)
LF=0.
DO 95 I=1,IS
DO 94 J=1,IC
N(I,J)=NX(NI,I,J)
L(I,J)=LX(NI,I,J)
LF=LF+L(I,J)/(FLOAT(IC))
94 H(I,J)=HX(NI,I,J)
95 CONTINUE
CALL LEVEL
AS=0.
AH=0.
AF=0.
DO 97 I=1,IS
AA=0.
DL=0.
DO 96 J=1,IC
DL=DL+L(I,J)/(FLOAT(IC)*LE)
D(I,J)=NX(NI,I,J)+H(I,J)
IF(D(I,J).LT.0.) D(I,J)=0.001
A(I,J)=H(I,J)*D(I,J)+H(I,J)*ABS(H(I,J))/(ZETA*FLOAT(IC))
IF(A(I,J).LT.0.) A(I,J)=0.001
IF(T,EQ,1) AS=AS+A(I,J)
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	IF(T,EQ,IS) AB=AB+A(I,J)	INLET	406
96	AAA=AA+A(I,J)	INLET	407
	IF(AA.LT,AMIN(NI)) AMIN(NI)=AA	INLET	408
97	AE=AE+DL/AA	INLET	409
	AMIN(I,NT)=AMIN(NI)	INLET	410
	AE=1./AE	INLET	411
	IF(I=NT,EG,1) CALL WT1	INLET	412
	IF(I=NT,EG,2) CALL WT2	INLET	413
	IF(I=NT,EG,3) CALL WT3	INLET	414
	DO 140 I=1,IS	INLET	415
	DO 139 J=1,IC	INLET	416
	MX(NI+I,J)=M(I,J)	INLET	417
139	MX(NI+I,J)=M(I,J)	INLET	418
140	CONTINUE	INLET	419
	RNK(NI,2)=AE/(2.*LE)*(1./(AR**2)=1./(AS**2))*QQ*QQ	INLET	420
	RNK(NI,3)=G*AE/LE*(HB=HS)	INLET	421
	DO 45 I=1,IS	INLET	422
	AC=M.	INLET	423
	DO 84 J=1,IC	INLET	424
84	AC=AC+A(I,J)	INLET	425
	DO 83 J=1,IC	INLET	426
83	RNK(NI,4)=RNK(NT,4)+AF/(LE*AC)*G*N(I,J)**2*ABS(M(I,J)*QQ)*	INLET	427
	1*(I,J)+CG/(2.20*0(T,J)**0.33333*A(I,J)**2)*L(I,J)*B(I,J)	INLET	428
85	CONTINUE	INLET	429
	RNK(NI,1)=RNK(NI,2)+RNK(NI,3)+RNK(NI,4)	INLET	430
	DERV(NI)=RNK(NI,1)	INLET	431
	C FIND THE RELATIVE RANK OF TERMS. NORMALIZE BY THE LARGEST TERM.	INLET	432
	XMAX=0.	INLET	433
	DO 101 I=1,4	INLET	434
101	IF(ABS(RNK(NI,I)).GT,XMAX) XMAX=ABS(RNK(NI,I))	INLET	435
	DO 102 I=1,4	INLET	436
102	RNK(NI,I)=100.*RNK(NI,I)/XMAX	INLET	437
100	CONTINUE	INLET	438
	DERV(NINLET+1)=QT/ARAY+QINFLO/ABAY	INLET	439
	RETURN	INLET	440
	END	INLET	441
	SUBROUTINE TPWRT(NINLET,X,HS,QINFLO,Y,AMINI,RNK,NT)	INLET	442
C	SUBROUTINE TO WRITE HYDRAULIC INFORMATION ON TAPES	INLET	443
	DIMENSION RNK(3,4),Y(5),AMINI(3)	INLET	444
	HOURS=X/3600.	INLET	445
	NT=NT+1	INLET	446
	DO 100 NI=1,NINLET	INLET	447
	IUNIT=NT+1	INLET	448
	V=Y(NI)/AMINI(NT)	INLET	449
100	WRITE(IUNIT) HOURS,HS,QINFLO,Y(NINLET+1),V,Y(NI),(RNK(NI,J),J=1,4)	INLET	450
	RETURN	INLET	451
	END	INLET	452

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	SUBROUTINE LEVEL	INLET	453
C	THIS ROUTINE COMPUTES WATER LEVELS THROUGHOUT THE INLET ASSUMING LEVEL	INLET	454
C	ARE LINEAR FROM BAY TO SEA	INLET	455
	REAL L,LENGTH,LIN,LX,N,NX	INLET	456
	COMMON/NUMS/NI,G,NINLET,ICM(3),ISE(3),QB,L(7,7),B(7,7),D(7,7),	INLET	457
	1 A(7,7),N(7,7),W(7,7),V(7,7),O(7,7),MS,MB,H(7,7),IC,IS,AMINI(3),	INLET	458
	1B=INI(3),LIN,QX(3),QINFLO,ABAY,LENGTH(3)	INLET	459
	DO 20 J=1,IC	INLET	460
	XL=0.	INLET	461
	DO 10 I=1,IS	INLET	462
10	XL=XL+L(I,J)	INLET	463
	XX=L(I,J)/2.	INLET	464
	H(I,J)=MS+(MB=MS)/XL*XX	INLET	465
	DO 11 I=2,IS	INLET	466
	XX=(L(I=1,J)+L(I,J))/2.*XX	INLET	467
11	H(I,J)=MS+(MB=MS)/XL*XX	INLET	468
20	CONTINUE	INLET	469
	RETURN	INLET	470
	END	INLET	471
	 SUBROUTINE SEA(MS,TIME)	INLET	472
C	THIS SUBROUTINE DETERMINES THE FORCING SEA LEVEL EITHER FROM	INLET	473
C	EQUAL=TIME=SERIES DATA (IF AVAILABLE) OR BY SINUSODIAL FORCING.	INLET	474
	COMMON /NUM3/AO,T,AR,RETA	INLET	475
	DIMENSION Y(52)	INLET	476
	NN=NN+1	INLET	477
	IF(NN.NE.1) GO TO 10	INLET	478
	READ(5,1) TDEL,NPTS	INLET	479
1	FORMAT(14X,F6.2,6X,T3)	INLET	480
	TDEL=TDEL*60.	INLET	481
C	HEAD SEA LEVEL EQUAL TIME SERIES DATA THE FIRST TIME SEA IS CALLED	INLET	482
C	IF NPTS IS GREATER THAN 1	INLET	483
	IF(NPTS.GT.1) READ(5,2) (Y(J),J=1,NPTS)	INLET	484
2	FORMAT(10F10.5)	INLET	485
	IF(NPTS.GT.1) WRITE(6,3) (Y(J),J=1,NPTS)	INLET	486
3	FORMAT(1X,16F6.2)	INLET	487
	N1=NPTS+1	INLET	488
	N2=NPTS+2	INLET	489
	Y(N1)=Y(1)	INLET	490
	Y(N2)=Y(2)	INLET	491
10	IF(NPTS.LT.1) GO TO 100	INLET	492
C	INTERPOLATE IN TIME	INLET	493
	IT=TIME/T	INLET	494
	XT=TIME-IT*T	INLET	495
	J=XT/TDEL	INLET	496
	J=J+1	INLET	497
	MS=Y(J)+((Y(J+1)-Y(J))*(XT-(J-1)*TDEL)/TDEL)	INLET	498
	RETURN	INLET	499
C	DETERMINE LEVEL IF SEA LEVEL FLUCTUATION IS SINUSODIAL	INLET	500
100	MS=AO* SIN(2.*3.14158*TIME/T)	INLET	501
	RETURN	INLET	502
	END	INLET	503

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<pre> SUBROUTINE HELM(THELM,AB,CORL) C ESTIMATE THE INLET-RAY HELMHOLTZ PERIOD C OF THE INLET/RAY SYSTEM (NEGLECT FRICTION) REAL L,LENGTH,LTN,LX,N,NX COMMON/NUMS/NI,G,NINLET,ICH(3),ISE(3),QR,L(7,7),B(7,7),D(7,7), 1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),HS,HB,H(7,7),IC,IS,AMINI(3), IRMINI(3),LIN,QX(3),QINFLO,ARRAY,LENGTH(3) DIMENSION CORL(3) C USE FIVE ITERATIONS TO OBTAIN THE ESTIMATE DO 1000 I=1,5 SUM=0. DO 100 NN=1,NINLET AMIN=AMINI(NN) 100 SUM=SUM+AMIN/(LENGTH(NN)*CORL(NN)) THELM=2.*3.14159* SQRT(AB/G)/ SQRT(SUM) C ESTIMATE THE HELMHOLTZ PERIOD DO 101 NN=1,NINLET C ESTIMATE THE INLET LENGTH CORRECTION DUE TO RADIATION 101 CORL(NN)=RMINI(NN)/3.14159*ALOG(3.14159*BMINI(NN)/( SQRT( 132.7*AMINI(NN)/RMINI(NN))*THELM)) 1000 CONTINUE C CONVERT THE HELMHOLTZ PERIOD TO HOURS THELM=THELM/3600. RETURN END </pre>	<pre> INLET 504 INLET 505 INLET 506 INLET 507 INLET 508 INLET 509 INLET 510 INLET 511 INLET 512 INLET 513 INLET 514 INLET 515 INLET 516 INLET 517 INLET 518 INLET 519 INLET 520 INLET 521 INLET 522 INLET 523 INLET 524 INLET 525 INLET 526 INLET 527 INLET 528 </pre>
<pre> SUBROUTINE WT1 C THIS SUBROUTINE WEIGHS THE FLOW IN EACH SECTION SO THAT FRICTION C IN THAT SECTION IS MINIMIZED. THIS MEANS THAT AT EACH SECTION FLOW IS C ALLOWED TO REDISTRIBUTE ITSELF THROUGHOUT THE CHANNELS TO MINIMIZE FR C HOWEVER, FLOW PERPENDICULAR TO THE CHANNELS IS ASSUMED TO BE SMALL AND C FLOW IS NOT INCLUDED IN THE EQUATIONS OF MOTION. BY MINIMIZING FRICTI C ROUTINE GIVES AN UPPER LIMIT FOR RAY LEVEL FLUCTUATIONS AND INLET VELO REAL L,LENGTH,LTN,LX,N,NX COMMON/NUMS/NI,G,NINLET,ICH(3),ISE(3),QR,L(7,7),B(7,7),D(7,7), 1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),HS,HB,H(7,7),IC,IS,AMINI(3), IRMINI(3),LIN,QX(3),QINFLO,ARRAY,LENGTH(3) DIMENSION C(20) DO 100 I=1,IS SUMC=0. DO 50 J=1,IC C(J)=A(I,J)**2*(D(I,J)**.333)/ 1 (N(I,J)**2*QX(NI)**2*B(I,J)*L(I,J)) 50 SUMC=SUMC+C(J) DO 60 J=1,IC 60 W(I,J)=C(J)/SUMC 100 CONTINUE RETURN END </pre>	<pre> INLET 529 INLET 530 INLET 531 INLET 532 INLET 533 INLET 534 INLET 535 INLET 536 INLET 537 INLET 538 INLET 539 INLET 540 INLET 541 INLET 542 INLET 543 INLET 544 INLET 545 INLET 546 INLET 547 INLET 548 INLET 549 INLET 550 INLET 551 </pre>

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SUBROUTINE WT2
C ROUTINE TO DETERMINE THE GRID WEIGHTING FUNCTION ASSUMING THAT
C FLOW IN A GIVEN CHANNEL IS THE SAME ALONG THE ENTIRE CHANNEL
C FLOW IS DISTRIBUTED IN CHANNELS TO GIVE A MINIMUM TOTAL FRICTION
C FRICTION IN THIS ROUTINE WILL BE SLIGHTLY HIGHER THAN IN WT1 AND THE
C IN THIS SYSTEM IS CONSISTANT WITH THE EQUATIONS OF MOTION.
      REAL L,LENGTH,LIN,LX,N,NX
      COMMON/NUMS/NI,G,NINLET,ICH(3),ISE(3),GR,L(7,7),B(7,7),D(7,7),
      1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),MS,MB,M(7,7),IC,IS,AMINI(3),
      1HMINI(3),LIN,QX(3),QINFLO,ABAY,LENGTH(3)
      DIMENSION C(20)
      SUMC=0.
      DO 100 I=1,IC
        C(I)=0.
        DO 50 J=1,IS
          C(I)=C(I)+(N(J,I)**2*QX(NI)**2*(B(J,I)*L(J,I))/
          1 (A(J,I)**2+(D(J,I)**.333333))
        C(I)=1./C(I)
      100 SUMC=SUMC+C(I)
        DO 70 J=1,IS
          DO 60 I=1,IC
            W(J,I)=C(I)/SUMC
          70 CONTINUE
        RETURN
      END
INLET 552
INLET 553
INLET 554
INLET 555
INLET 556
INLET 557
INLET 558
INLET 559
INLET 560
INLET 561
INLET 562
INLET 563
INLET 564
INLET 565
INLET 566
INLET 567
INLET 568
INLET 569
INLET 570
INLET 571
INLET 572
INLET 573
INLET 574
INLET 575
INLET 576

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SUBROUTINE WT3
C THIS ROUTINE ASSUMES THAT DISCHARGE IS EQUALLY DISTRIBUTED THROUGHOUT
C THE INLET GRID SYSTEM. IN GENERAL THIS WILL NOT BE TRUE BECAUSE IT IS
C DIFFICULT TO ACCURATELY DRAW THIS TYPE OF GRID BY EYE AND FLOW DISTRIB
C CHANGES WITH TIME IN MOST INLETS. THIS ROUTINE IS USEFUL IN GIVING AN
C VELOCITIES AND RAY LEVEL FLUCTUATIONS.
C GRIDS WITH DEPTHS LT 0.01 FEET ARE ASSUMED TO HAVE NO FLOW
      REAL L,LENGTH,LIN,LX,N,NX
      COMMON/NUMS/NI,G,NINLET,ICH(3),ISE(3),GR,L(7,7),B(7,7),D(7,7),
      1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),MS,MB,M(7,7),IC,IS,AMINI(3),
      1HMINI(3),LIN,QX(3),QINFLO,ABAY,LENGTH(3)
      DO 2 I=1,IS
        X=IC
        DO 1 J=1,IC
          IF(D(I,J).LT.0.01) X=X-1.
          IF(X.LE.0.) WRITE(6,100) NI,IS
        100 FORMAT(///,5X,(ERROR == INLET HAS DRIED UP AS INDICATED IN WT3),/
          1 5X,(INLET=I,I4,(SECTION=I,I4,///))
          IF(X.LE.0.) STOP
          DO 3 J=1,IC
            W(I,J)=1./X
          3 IF(D(I,J).LT.0.01) W(I,J)=0.
        2 CONTINUE
      RETURN
      END
INLET 577
INLET 578
INLET 579
INLET 580
INLET 581
INLET 582
INLET 583
INLET 584
INLET 585
INLET 586
INLET 587
INLET 588
INLET 589
INLET 590
INLET 591
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INLET 595
INLET 596
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INLET 598
INLET 599
INLET 600
INLET 601

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SUBROUTINE TABLE
C ROUTINE TO WRITE A TABLE OF INSTANTANEOUS HYDRAULICS
REAL L,LENGTH,LT,LX,N,NX
COMMON/NUM5/N1,G,NINLET,ICH(3),ISE(3),OR,L(7,7),B(7,7),D(7,7),
1 A(7,7),N(7,7),W(7,7),V(7,7),Q(7,7),HS,HB,H(7,7),IC,IS,AMINI(3),
1HMINI(3),LIN,QX(3),QINFLO,ARRAY,LENGTH(3)
COMMON/NUM1/Y(5),DERV(5),X,NT,INT,ZETA,HH
COMMON/NUM2/BX(3,7,7),DX(3,7,7),MX(3,7,7),WX(3,7,7),LX(3,7,7),NX(3
1,7,7)
COMMON/NUM4/RNK(3,4)
DIMENSION NAME(4)
DATA NAME/6HV(FPS),6HA(FT2),6HWEIGHT,6HLEVEL
HRSX/3600.
WRITE(6,1) HRS
1 FORMAT(1X, '-----')
1SX, (TIME, HOURS =1,F8,3)
DO 100 NJ=1,NINLET
WRITE(6,10) NJ,HS,HH,V(NJ)
10 FORMAT(//,10X,'INLET',1,13,/,10X,'(SEA LEVEL,FT=1,F7,2,/,10X,'(BAY LEVE
1L,FT=1,F7,2,/,10X,'(DISCHARGE,CFS=1,F10,4,/,2X,'(CHANNEL SECT
1ION 1 2 3 4 5 6)
IC=ICH(NJ)
IS=ISE(NJ)
DO 4 J=1,IC
DO 3 I=1,IS
A(I,J)=MX(NI,I,J)*(DX(NI,I,J)+MX(NI,I,J))+MX(NI,I,J)*ABS(MX(NI,I,J
1)))/(ZETA*FLD(AT(IC))
IF(A(I,J),LT,0.01) A(I,J)=0.
V(I,J)=V(NJ)*MX(NI,I,J)/A(I,J)
3 IF(A(I,J),LE,0.01) V(I,J)=0.
IF(J,EW,1) WRITE(6,50) J,NAME(4),(MX(NI,I,J),I=1,IS)
WRITE(6,69)
69 FORMAT(//)
WRITE(6,50) J,NAME(1),(V(I,J),I=1,IS)
50 FORMAT(4X,12,3X,A6,2X,6F10,2)
WRITE(6,50) J,NAME(2),(A(I,J),I=1,IS)
WRITE(6,50) J,NAME(3),(WX(NT,I,J),I=1,IS)
4 CONTINUE
WRITE(6,59) (RNK(NI,IT),I=1,4)
59 FORMAT(5X,(TEMP ACC=1,F7,1,1 CONV ACC=1,F7,1,1 FRIC=
1,1,F7,1)
VRAPRY(NJ)/AMINT(NJ)
WRITE(6,61) VBAR,AMINI(NJ)
61 FORMAT(5X,'MEAN VELOCITY AT THE MINIMUM AREA SECTION=1,F7,2,1 FT/S
1ECL,1 AMIN=1,F9,2,1 FT2(1)
100 CONTINUE
RETURN
END
INLET 602
INLET 603
INLET 604
INLET 605
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INLET 641
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INLET 643
INLET 644
INLET 645
INLET 646
INLET 647
INLET 648
INLET 649

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C	SUBROUTINE CRIT(NT,DELT,IUNIT,T,NCYCLES)	INLET	650
C	SUBROUTINE CRIT COMPARES 3 CONSECUTIVE FUNCTION POINTS	INLET	651
C	AND WRITES MIDDLE POINT IF IT IS A CRITICAL POINT	INLET	652
	DIMENSION F(3,5),MARK(5),TERM(4)	INLET	653
	DATA MARKA/1M /, MARKB/1M/	INLET	654
	REMTND TUNIT	INLET	655
	NLINES=0	INLET	656
	TF=7/3600.	INLET	657
	WRITE(6,1009)	INLET	658
	DO 1 N=1,2	INLET	659
1	READ(IUNIT) X=(F(N,J),J=1,5),(TERM(II),II=1,4)	INLET	660
	DO 100 N=3,NT	INLET	661
	READ(IUNIT) X=(F(3,J),J=1,5),(TERM(II),II=1,4)	INLET	662
	IF(X,LT,=1.0E+10) GO TO 101	INLET	663
	IOUT=0	INLET	664
	DO 2020 IA = 1, 5	INLET	665
	MARK(IA) = MARKA	INLET	666
2012	IF (F(2,IA) = F(1,IA)) 2012, 2020, 2014	INLET	667
2014	IF (F(3,IA) = F(2,IA)) 2020, 2015, 2015	INLET	668
	IF (F(3,IA) = F(2,IA)) 2015, 2015, 2020	INLET	669
C	CRITICAL POINT VALUE FOUND	INLET	670
2015	IOUT = 1	INLET	671
	MARK(IA) = MARKB	INLET	672
	IF(IA.EQ.1.AND.F(2,IA).GT.0.) HSH=F(2,IA)	INLET	673
	IF(IA.EQ.1.AND.F(2,IA).GT.0.) T1=X	INLET	674
	IF(IA.EQ.1.AND.F(2,IA).LT.0.) HSL=F(2,IA)	INLET	675
	IF(IA.EQ.1.AND.F(2,IA).LT.0.) T2=X	INLET	676
	IF(IA.EQ.3.AND.F(3,IA).GT.0.) HRH=F(3,IA)	INLET	677
	IF(IA.EQ.3.AND.F(3,IA).GT.0.) T3=X	INLET	678
	IF(IA.EQ.3.AND.F(3,IA).LT.0.) HHL=F(3,IA)	INLET	679
	IF(IA.EQ.3.AND.F(3,IA).LT.0.) T4=X	INLET	680
	IF(IA.EQ.4.AND.F(2,IA).LT.0.) VF=F(2,IA)	INLET	681
	IF(IA.EQ.4.AND.F(2,IA).GT.0.) VF=F(2,IA)	INLET	682
2020	CONTINUE	INLET	683
	DO 2025 IA = 1, 5	INLET	684
	F(1,IA) = F(2,IA)	INLET	685
2025	F(2,IA) = F(3,IA)	INLET	686
	IF (IOUT.EQ.0) GO TO 100	INLET	687
C	IF(X,LT,(NCYCLES=2)*TF) GO TO 100	INLET	688
	NLINES=NLINES+1	INLET	689
	IF(NLINES.GT.150) GO TO 100	INLET	690
	WRITE (6,2101) X=(F(1,IA),MARK(IA),IA=1,5)	INLET	691
100	CONTINUE	INLET	692
101	RENT	INLET	693
	AMPH=MBH/HSH	INLET	694
	AMPL=HBI/HSL	INLET	695
	PHM=ABS(T3-T1)*360./TF	INLET	696
	PHL=ABS(T4-T2)*360./TF	INLET	697
	WRITE(6,1011) AMPH,PHM,VF,AMPL,PHL,VE	INLET	698
	WRITE(6,1111) TF	INLET	699
1111	FORMAT( 5X,(TF=(F7,2)	INLET	700
	RETURN	INLET	701
2101	FORMAT (2F8.3,A1,-3PF8.3,A1,2(OPF7.3,A1),	INLET	702
	3PF8.3, A1, 2(F8.3, A1))	INLET	703
1009	FORMAT(4X,4MTIME,5X,2HMS,4X,6MIN,FLO,5X,2HMR,	INLET	704
1	5X,3HVEL,7X,1HG,/,5X,3HMS,5X,2HFT,5X,4HRCFS,	INLET	705
1	0X,2HFT,5X,3HFPS,4X,4HRCFS,/) )	INLET	706
1011	FORMAT(//,1X,(# CRITICAL POINT VALUE(,///,15X,	INLET	707
1	1WAVE PROPAGATION(,/,15X,(AG/AD(,5X,(PHASE LAG(DEG) MAX VEL(,	INLET	708
1	1//,2X,(HIGH WATER(,2X,3F10.4,/,	INLET	709
1	2X,(LOW WATER (,2X,3F10.4)	INLET	710
	END	INLET	711
		INLET	712

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C	SUBROUTINE READIN (X,Y,VFAC,XFAC,X0,XF,INDC,KK,LN,IUNIT)	INLET	713
C	SUBROUTINE TO READ SOLUTION TABULATION FROM FILE	INLET	714
C	DIMENSION V(9), VFAC(9)	INLET	715
	DT5=.5*1./60.	INLET	716
	READ (IUNIT) X, Y	INLET	717
	IF (X,LT,=1.E+10) KK=2	INLET	718
	INDC = 0	INLET	719
	IF (KK = 1) 10, 10, 50	INLET	720
10	IF (X0 = X = DT5) 20, 50, 50	INLET	721
20	IF (X = XF = DT5) 30, 25, 25	INLET	722
25	KK = 2	INLET	723
	GO TO 50	INLET	724
30	INDC = 1	INLET	725
	X = XFAC*(X = X0)	INLET	726
	V(LN) = VFAC(LN)*V(LN)	INLET	727
50	RETURN	INLET	728
	END	INLET	729
		INLET	730
	SUBROUTINE GRPHC(ALABL1,ALABL2,DELT,IUNIT,N1)	INLET	731
C		INLET	732
C	SUBROUTINE GRPHC WRITES PLOTTER TAPE FOR GRAPHICAL	INLET	733
C	OUTPUT OF SOLUTION	INLET	734
C		INLET	735
	DIMENSION HL(2), ISYM(5)	INLET	736
	DIMENSION YLABL(3),ALEGN(3,6),ALABL1(4),ALABL2(4),SYM(3),V(9),VFA	INLET	737
	IC(9),XX(2000),YY(2000),TT(9,2)	INLET	738
	DATA YLABL/10MHHEIGHTS, V/10MVELOCITIES=.3M=FT, FPS/	INLET	739
	DATA ALEGN/10MFLOW (KCF/10M) .3M .10MINLET VELO,10MCITY	INLET	740
	1 (FT/SEC),10MHAY LEVEL(.10MFT) .3M .10MINFLOW .10M	INLET	741
	2 .3M .10MOCEAN LEVE,10ML(FT) .3M .10MLEGEND .10M	INLET	742
	3 .3M /	INLET	743
	DATA HL/10MHOSERVED H,10MAY TIDE /	INLET	744
	DATA ISYM/5,4,3,2,1/	INLET	745
	DATA TT(6,1)/10MTEMPORAL A/	INLET	746
	DATA TT(6,2)/10MCCEL /	INLET	747
	DATA TT(7,1)/10MCONVECTIVE/	INLET	748
	DATA TT(7,2)/10M ACC /	INLET	749
	DATA TT(8,1)/10MPRESSURE H/	INLET	750
	DATA TT(8,2)/10MHEAD /	INLET	751
	DATA TT(9,1)/10MBOTTOM STM/	INLET	752
	DATA TT(9,2)/10MESH /	INLET	753
C		INLET	754
C	READ INFORMATION TO DIRECT PLOTTING	INLET	755
C		INLET	756
C	FIRST CARD	INLET	757
C	X0 = STARTING TIME OF PLOT (HRS)	INLET	758
C	XF = ENDING TIME OF PLOT (HRS)	INLET	759
C	SCALX = TIME AXIS SCALE IN HOURS PER INCH	INLET	760
C	YLO = MINIMUM VALUE OF TIDAL HEIGHTS (FT)	INLET	761
C	YL = OVERALL HEIGHT OF PLOT (INCHES)	INLET	762
C	YLSCL = SCALE OF TIDAL HEIGHTS (FT/INCH)	INLET	763
C	YRO = MINIMUM VALUE OF FLOWS (THOUSANDS OF CUBIC FEET PER SECOND)	INLET	764
C	YRSCAL = SCALE OF FLOW ( THOUSANDS OF CUBIC FEET PER SECOND/INCH)	INLET	765
C		INLET	766
C	CARD 2	INLET	767
C	VVO = MINIMUM VELOCITY (FT/SEC)	INLET	768
C	VVSCAL = SCALE OF VELOCITY (FEET PER SECOND/INCH)	INLET	769
C	SCAL = SCALE FACTOR FOR TOTAL PLOT SIZE	INLET	770
C	IQ = NOT EQUAL TO ZERO FOR A PLOT OF INLET DISCHARGE	INLET	771
C		INLET	772

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IF (N1.EQ.1)	INLET	773
1 READ ( 5,2001) X0,XF,SCALX,YL0,YL,YLSCAL,YR0,YRSCAL,YV0,YVSCAL,	INLET	774
1 SCALE=IQ	INLET	775
2001 FORMAT(AF10.5,/,3F10.5,I10)	INLET	776
*WRITE(A,2002) X0,XF,SCALX,YL0,YL,YLSCAL,YR0,YRSCAL,YV0,YVSCAL,	INLET	777
1 SCALE=IQ	INLET	778
2002 FORMAT(///,5X,(PLOT INFORMATION,/,	INLET	779
1 1X,6F10.5,/,1X,3F10.5,I10)	INLET	780
C DETERMINE SYMBOL SPACING	INLET	781
LINTYP=.25*SCALX/(DELT/3000.)	INLET	782
WRITE(0,1215) LINTYP	INLET	783
1215 FORMAT(1X,(LINTYP=(.16)	INLET	784
C	INLET	785
C PLOT LEGEND	INLET	786
C	INLET	787
CALL SYMBOL(1,0.=YL/2,=.0,20,0,MLEGEND,0,.06)	INLET	788
DO 20 LN = 1, 5	INLET	789
INDX = 0	INLET	790
YP=YL/2,=.0,LLN=.2	INLET	791
LLN=ISYM(LN)	INLET	792
CALL SYMBOL(0,YP,00,14*LLN,0,=.1)	INLET	793
SYM(1) = ALEGN(1,LLN)	INLET	794
SYM(2) = ALEGN(2,LLN)	INLET	795
SYM(3) = ALEGN(3,LLN)	INLET	796
CALL SYMBOL( .4,YP,0,1 ,SYM,0,23)	INLET	797
20 CONTINUE	INLET	798
C PLOT TITLE	INLET	799
CALL SYMBOL(3.5,=YL/2,=1,0,21,ALABL1,0,32)	INLET	800
CALL SYMBOL(3.5,=YL/2,=1,4,21,ALABL2,0,32)	INLET	801
C PLOT AXFS	INLET	802
YLO=YL/2,=YLSCAL	INLET	803
CALL AXISO(,=YL/2,.16MVELOCITY, FT/SEC,16,YL,90,=YV0	INLET	804
1,YVSCAL)	INLET	805
CALL AXIS(,=YL/2,.11MHEIGHTS, FT,11,YL,90,=YLO,YLSCAL)	INLET	806
CALL AXISO(,=YL/2,.9HTIME, HRS,=9,(XF=X0)/SCALX,0,0,=SCALX)	INLET	807
IF (TR,NE,0)	INLET	808
1CALL AXIS((XF=X0)/SCALX,=YL/2,.10HFLOW, KFPS=10,YL ,90,=YL/2,=YR	INLET	809
1SCAL,YRSCAL)	INLET	810
IF (TG,EO,0) CALL PLOT(( XF=X0)/SCALX,=YL/2,.3)	INLET	811
IF (TG,EO,0) CALL PLOT((XF=X0)/SCALX,YL/2,.2)	INLET	812
CALL PLOT((XF=X0)/SCALX,YL/2,.3)	INLET	813
CALL PLOT(0,=YL/2,.2)	INLET	814
YFAC(1) = 1./YLSCAL	INLET	815
YFAC(2) = 0.001/YRSCAL	INLET	816
YFAC(3) = YFAC(1)	INLET	817
YFAC(4) = 1./YVSCAL	INLET	818
YFAC(5) = YFAC(2)	INLET	819
DO 1234 I=1,9	INLET	820
1234 YFAC(I)=.003	INLET	821
XFAC = 1./SCALX	INLET	822
DO 15 I = 1, 9	INLET	823
C IF I=5 DO NOT PLOT DISCHARGE	INLET	824
IF (TG,EO,0,AND,I,EO,5) GO TO 15	INLET	825
CON=YL/2,*(I=5)=0.8	INLET	826
CALL PLOT (0,= 0,= 3)	INLET	827
KK = 1	INLET	828
ISUM=0	INLET	829
HE=IND TUNIT	INLET	830

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65	INDX = 0	INLET	831
	CALL READIN (X,Y,YFAC,XFAC,X0,XF,INDC,KK,I,IUNIT)	INLET	832
	GO TO (70, 80), KK	INLET	833
70	IF(INDC,LT,0) GO TO 65	INLET	834
72	ISUR=ISUR+1	INLET	835
	IF(ISUR,GE,1998) ISUR=1998	INLET	836
	XX(ISUR)=X	INLET	837
	YY(ISUR)=Y(I)	INLET	838
	IF(1,GT,5) YY(ISUR)=YY(ISUR)+COR	INLET	839
	IF(ISUR,EG,1998) GO TO 80	INLET	840
	GO TO 65	INLET	841
80	XX(ISUR+1)=0.	INLET	842
	XX(ISUR+2)=1.0	INLET	843
	YY(ISUR+1)=0.	INLET	844
	YY(ISUR+2)=1.	INLET	845
	C PLOT CURVES ( DO NOT PLOT IF EQUAL TO ZERO THROUGHOUT)	INLET	846
	IF(YY(ISUR+2).EQ,0.0,AND,	INLET	847
	1 YY(ISUR+1).EQ,0.0,AND,YY(ISUR).EQ,0.0) GO TO 85	INLET	848
	IF(1,GT,5) GO TO 885	INLET	849
	CALL LINE(XX,YY,ISUR,1,LINTVP,1)	INLET	850
	GO TO 85	INLET	851
885	CALL LINE(XX,YY,ISUR,1,0.0)	INLET	852
	CALL PLOT((XF=X0)/SCALX+COR,3)	INLET	853
	CALL PLOT(0.,COR,2)	INLET	854
	SYM(1)=TT(1,1)	INLET	855
	SYM(2)=TT(1,2)	INLET	856
	CALL SYMBOL(=2,2,COR,0.1,SYM,0.,20)	INLET	857
85	CONTINUE	INLET	858
	C READ PHOTOTYPE HAY TIDE (DATA STARTS AT BEGINNING OF PLOT,SAME DATUM)	INLET	859
	IF(NI,NP,1) GO TO 2019	INLET	860
	READ(S,1) TDEL,NPTS	INLET	861
1	FORMAT(34X,F6.2,6X,T3)	INLET	862
	IF(NPTS,LT,2) GO TO 2019	INLET	863
	IF(NPTS,GT,1) READ(S,2) (YY(J),J=1,NPTS)	INLET	864
2	FORMAT(MF10,5)	INLET	865
	XX(NPTS+1)=0.	INLET	866
	XX(NPTS+2)=1.	INLET	867
	YY(NPTS+1)=0.	INLET	868
	YY(NPTS+2)=1.	INLET	869
	DO 3 J=1,NPTS	INLET	870
	YY(J)=YY(J)+YFAC(1)	INLET	871
3	XX(J)=(TDEL/N0)*XFAC*(J-1)	INLET	872
	CALL PLOT(XX(1),YY(1),3)	INLET	873
	CALL LINE(XX,YY,NPTS,1,0.0)	INLET	874
	CALL PLOT(XX(NPTS/2),YY(NPTS/2),3)	INLET	875
	CALL PLOT(XX(NPTS/2),YY(NPTS/2)+.75,2)	INLET	876
	CALL SYMBOL(XX(NPTS/2)+.1,YY(NPTS/2)+.75,.1,BL,0.,17)	INLET	877
2019	CALL PLOT((XF=X0)/SCALX+4.,0.,=3)	INLET	878
	RETURN	INLET	879
	END	INLET	880

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